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The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it. Editorials are by the Editor-in-Chief unless otherwise indicated and do not necessarily represent the opinion of the Society as a whole. The "leaders" preceding major articles are to be regarded as editorial additions.

EDITORIAL

THE FACTS FOR A PREMISE

A PLANNED forest economy to succeed must be sound. To be sound it must, we surely can all agree, be based on a thorough knowledge of the facts and an intelligent interpretation of them. We can also agree, undoubtedly, that to start with a preconceived conclusion and then to build a brief in support of it that is based on a distortion of the facts, or on alleged facts manufactured to fit the occasion will inevitably lead in the end to disaster. The forest economist in his effort to solve our "forest problem" must be as truly scientific in his processes as the investigator in any other realm of science.

Sometimes an intriguingly plausible argument can be invented out of thin air in support of a perfectly sound objective. Too often, however, such an argument is based on a distortion of the facts or a disregard of them. If the argument is particularly attractive and convincing, the temptation to use it anyhow is too often irresistible. To succumb to such temptation is dangerous, because the truth eventually will out and is especially certain to rise up to confront us in such a long time undertaking as a planned forest economy for the nation. There is evidence for suspecting that we may have already committed error of that sort to an extent that has handicapped rather than advanced the very cause to which all foresters are making their respective contributions; viz, to bring about the conservation and sustained production of the forest resource throughout the country, under some wise policy and plan which will render the resource of maximum usefulness to the economic and social welfare of the whole nation and all its parts,—or, to put it more curtly, though negatively, as some prefer—"to stop forest devastation."

In striving for this objective, up to a few short years ago, we all of us were still planing our timber-growing economy on the premise of an impending timber famine. We had statistical evidence (some of it not based on fact, it is feared, because facts were unavailable) to show that the demand for timber as a raw material far exceeded the supply both present and prospective. Such figures as we had on annual consumption, on the supply of virgin timber, on the rate of regrowth, it was easy to put together in a few deft arithmetical computations to establish beyond peradventure of a doubt that in order to insure the nation its future timber needs, we must put into effect, and that right speedily, some scheme by which every last acre of our whole forest heritage would be maintained in, or restored to a state of continuous maxi-

mum growth productivity. The problem as we saw it then was largely a silvicultural one—how to make more and better trees grow faster. The demand for them we thought would be so insistent, that they would sell themselves as fast as they were ready at progressively higher prices.

The timber famine propaganda was skillfully done and partially successful. It stimulated support of expanded public forest ownership, encouraged the development of improved training facilities at the schools of forestry and helped to create interest in the possibilities of private forestry. Unfortunately, however, its influences in some respects were adverse to the very cause it was intended to serve; it stimulated speculation in virgin stumpage, forcing the market price well above the intrinsic investment value, it encouraged over-expansion and over-capitalization of forest industry, and worst of all was a strong contributory factor in the development and promotion of substitutes for wood. In helping to bring about a balance between supply and demand, industry and the consumer instead of building up the supply chose rather to reduce the demand, thus refuting the assumptions of our earlier forest economists that the demand for wood is "inelastic."

Herein, there have been at work, it would seem, "Vast surging forces," not yet fully comprehended by all members of the profession, which actually "are overwhelming the accepted truisms of the past,"[1] and our forest problem is no longer a comparatively simple and direct silvicultural one of growing enough timber to satisfy the insatiable appetite of the consumer for wood and its products. It is no longer sufficient to say, "*There is no surplus of growing trees*, but, on the contrary, an increasing need to guard against a future shortage. Forest industries can be developed to support many more people than they do at present *without the slightest risk of glutting the market.*"[2]

When we have succeeded throughout the nation in making more and better trees grow faster on all available land, when we have solved thereby the silvicultural problem involved, our task will have been only half completed. Is it, in sooth, fair to the lay public to leave it with the misconception that the situation is at all otherwise? Since it is the objective of our profession to bring about a condition wherein the nation's whole forest resource is permanently and continuously of maximum benefit to the social and economic welfare of all the people should we not, at least among ourselves, frankly recognize that our professional effort must extend far beyond the mere limits of timber growing and devote itself intensively to the development and expansion of the uses for wood, and the innumerable things it can be made into, in order, not only that those of us engaged in the growing of timber crops may be adequately reimbursed for our labors, but also, and what is more important, in order that our timber crops as they grow to maturity, may profitably employ many more thousands in the harvesting of them and the conversion of them into the thousands of useful commodities which the consuming public should be taught to require in ever increasing quantities.

The factual evidence which has been accumulating before our eyes and ears of recent years all point to the conclusion that the consumer, as left to his own resources and to the tender mercies of the purveyor of wood substitutes, is rapidly curbing his appetite for wood and accommodating himself to a progressively slimmer wood diet. To be convinced of this one needs only to read "How Much

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[1] See pp. 781-782, Journal of Forestry, October, 1934.
[2] Annual report of the Secretary of Agriculture for 1934. p. 76.

Timber Has America Cut" (JOURNAL OF FORESTRY, January, 1935), and study the curves therein portrayed, or, on page 866-868 of the March, 1934 issue, the interchange of letters under the heading "Forest Utilization Again to the Front," or, better yet, study carefully that chapter in our forest encyclopedia, the Copeland Report, beginning on page 245, which bears the title "Our National Timber Requirements" under the authorship of Frank J. Hallauer.

One would do well to read also the recent letter to the Editor, which appears further on in this issue, from C. J. Heller, Forest Engineer for the Texas Company, and a member of our Society of long standing. The Texas Company, it is plain, when 15 years ago it initiated its systematic plans for a future timber supply, committed the error of basing them on the false premise of an impending timber famine and through that error has suffered accordingly.

Should we then persist in basing our plans for a national forest economy on the same false premise? Is it not rather our professional duty to recognize the facts as they actually exist and to use them as a premise on which to base such public forest policies as we may have to propose?

Clearly in the light of present day knowledge our forestry shoe is distinctly on the other foot. Today we must cultivate and develop our markets for wood and its products to the utmost limits in order to provide the widest possible opportunity for the profitable growing, harvesting and conversion of commercial timber crops. If our forest problem concerned itself only with effecting a balance between timber supply and use we could safely leave its solution to the promoter of wood substitutes. Since, however, it is more important, more necessary, now than it ever was to develop the forest resource to the point where it contributes to the utmost to the general economic and social welfare we must, as a profession, frankly discard the old out-worn theories (beautiful as they once seemed) and recognize freely that the task of making more and better trees grow faster, slips for the nonce into the background and is replaced by the task of building and expanding the use of wood as a raw material until the sustained consumer-demand for things made of it will permit us to employ continuously the maximum number of hands in the most intensive silvicultural management of every last available acre of timber growing land and additional thousands, or millions, in the profitable conversion and distribution of the timber crops and their products as rapidly as they reach the time of harvest.

Surely, to lay aside old-fashioned, unsound premises and to replace them with the facts will not destroy our forest problem, it will only insure its correct solution. Even though by such professional honesty we may be rendering the problem more complicated and more difficult of solution we are at the same time making it more intriguing—a more stimulating challenge to our professional skill. "The problem which challenges is that of making forest lands affirmatively contribute, with security and stability, to the permanent support of their fair share of the nation's population."[3]

FRANKLIN REED.

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[3] F. A. Silcox in *American Forests*, January, 1935.

THE PASSING OF THE LOLO TRAIL

By ELERS KOCH

A somewhat partisan discussion of an important and controversial question of land use, "What shall be done with the low-value back country." The author, who is evidently a wilderness area enthusiast, maintains that the Forest Service has already made a serious mistake in opening the Selway wilderness with roads, and goes so far as to question the worth-whileness of attempting fire control in that country.

THE Lolo Trail is no more.

The bulldozer blade has ripped out the hoof tracks of Chief Joseph's ponies. The trail was worn deep by centuries of Nezperce and Blackfeet Indians, by Lewis and Clark, by companies of Northwest Company fur traders, by General Howard's cavalry horses, by Captain Mullan, the engineer, and by the early-day forest ranger. It is gone, and in its place there is only the print of the automobile tire in the dust.

What of the camps of fragrant memory —Camp Martin, Rocky Ridge, No Seeum Meadows, Bald Mountain, Indian Grave, Howard Camp, Indian Post Office, Spring Mountain, Cayuse Junction, Packers Meadows? No more will the traveler unsaddle his ponies to roll and graze on the bunch grass of the mountain tops. No more the "mule train coughing in the dust." The trucks roll by on the new Forest Service road, and the old camps are no more than a place to store spare barrels of gasoline.

No more will the mountain man ride the high ridges between the Kooskooskee and the Chopunnish. "Smoking his pipe in the mountains, sniffing the morning cool."

It is now but three hours' drive from the streets of Missoula to the peak where Captain Lewis smoked his pipe and wrote in his journal: "From this elevated spot we have a commanding view of the surrounding mountains, which so completely enclose us that though we have once passed them, we almost despair of ever escaping from them without the assistance of the Indians." Only ten years ago it was just as Lewis and Clark saw it.

So it is everywhere.

The hammer rings in the CCC camp on the remotest waters of the Selway. The bulldozer snorts on Running Creek, that once limit of the back of the beyond. The moose at Elk Summit lift their heads from the lily pads to gaze at the passing motor truck. Major Fenn's beloved Coolwater Divide has become a motor road.

No more can one slip up to the big lick at Powell for a frosty October morning and see the elk in droves. The hunters swarm in motor cars in the public campgrounds.

And all to what end? Only a few years ago the great Clearwater wilderness stretched from the Bitterroot to Kooskia; from the Cedar Creek mines to the Salmon River and beyond. No road and no permanent human habitation marred its primitive nature. There it lay—the last frontier—an appeal to the mind of the few adventurous souls who might wish to penetrate its fastnesses and plunge for weeks beyond human communication.

The Forest Service sounded the note of progress. It opened up the wilderness with roads and telephone lines, and airplane landing fields. It capped the mountain peaks with white-painted lookout houses, laced the ridges and streams with a network of trails and telephone lines, and poured in thousands of firefighters year after year in a vain attempt to control forest fires.

Has all this effort and expenditure of millions of dollars added anything to human good? Is it possible that it was all a ghastly mistake like plowing up the good buffalo grass sod of the dry prai-

ries? Has the country as it stands now as much human value as it had in the nineties when Major Fenn's forest rangers first rode into it?

To answer the questions let us first examine what manner of country this is, and what it is good for. I have before me a map of North Idaho made up on the basis of the combined judgment of the best qualified forest officers, which shows in green Zone 1, the area of unquestioned value for timber production; in white Zone 2, which may possibly have some future timber productive value; and in yellow Zone 3, which, owing to altitude, rugged topography, permanent inaccessibility or inferior timber growth, will never, so far as best present judgment indicates, come into the picture as timber producing land.

The three northern national forests in the state are considerably cut up as to zones, but with green and white greatly predominating on the map. Further south the picture changes. The upper reaches of the North Fork of the Clearwater, the Lochsa, Selway and Salmon Rivers form a great solid block of yellow Zone 3 on the map, covering 3000 square miles, or two million acres in round numbers. This is a different geological formation. Departing from the pre-Cambrian shales of the north end of the state, this is part of the great granite batholith of Central Idaho. It is a country of deep canyons, rushing, boulder-strewn rivers, mountain lakes and high peaks. The decomposed granite soil is thin, coarse-grained and shallow. Prior to the intervention of the Forest Service, the tide of civilization surged round it, and few men entered it. Elk, moose, mountain goats, deer and furbearers maintained a natural existence, protected by the country itself.

It seems obvious that whatever value the area may have, it is not for timber production. Rather its value lies in whatever pleasure man may get out of its recreational resources in the way of isolation, scenery, fish and game.

I would that I could turn the clock back and make a plea for preserving the area as it was twenty-five or even five years ago. Alas, it is too late. Roads are such final and irretrievable facts.

The Forest Service built these hundreds of miles of road and these thousands of miles of trail and telephone line for one purpose only—to facilitate the suppression of forest fires.

The whole history of the Forest Service's attempt to control fire in the back country of the Selway and Clearwater is one of the saddest chapters of the history of a high-minded and efficient public service. In the face of the most heroic effort and the expenditure of millions of dollars and several lives, this country has been swept again and again by most uncontrollable conflagrations. The Lochsa Canyon is burned and reburned from Pete King to Jerry Johnson, and the Selway from the Forks to Moose Creek.

Many fires have been controlled, but when the time is ripe for a conflagration man's efforts have been puny in the face of Nature's forces. I am not criticizing the efforts of others. I have personally taken a considerable part in four major fire campaigns on the Lochsa River, in 1910, 1919, 1929 and 1934. Each year we made a greater effort and threw larger forces of men into the battle, but so far as results are concerned there is little difference between 1919, when crews of thirty or forty men, in a vain but courageous gesture, were trailing the leeward end of each of five or six gigantic fires, and 1934, when firefighters were counted in thousands and the fires swept 180,000 acres.

When fire gets a good start in the dry fire-killed cedar and white fir of the Selway and burning conditions are just right, the whole United States Army, if it was on the ground, could do nothing but keep out of the way. After years of experience I have come to the con-

sidered conclusion that control of fire in the back country of the Selway and Lochsa drainages is a practical impossibility. I firmly believe that if the Forest Service had never expended a dollar in this country since 1900 there would have been no appreciable difference in the area burned over. It is even possible that, by extinguishing fires in favorable seasons which would have run over a few hundred or a few thousand acres, the stage was only set for the greater conflagrations which went completely beyond fireline control. After all, this country existed and maintained a general timber cover before man was born, and for millions of years before the Forest Service came into being. Surely its existence as wild land capable of sheltering its game and holding the watershed together cannot now be altogether dependent on the efforts of the Forest Service. No important new element has been introduced. Not a single one of the greater fires which have swept the country since 1910 has been man-caused. And even 130 years ago we have Lewis' and Clark's testimony that the Indians habitually set fires for such a trivial purpose as to insure fair weather for a journey.

Since the two-million acre unit under consideration is now part of five national forests—the Selway, Nezperce, Clearwater, Lolo and Bitterroot—it is difficult to segregate past costs of administration in this country.

The records show that since 1912 the Selway Forest alone has expended the vast sum of $3,065,000.00 for all purposes, with receipts of only $76,000.00. This does not include the present year's cost, which must have amounted to over half a million dollars. The Selway expenditures for the past four fiscal years, 1931 to 1934, have averaged $288,000.00 annually. If the expenditures by the four other national forests within the low-value zone are added to the Selway, it is probable that the Forest Service has sunk at least five million dollars to date in the area, and will continue to expend at the rate of $200,000.00 to $300,000.00 a year, with practically no hope of timber-sale receipts or more than a trivial amount in grazing fees to offset the expenditures.

What is the future line of action which should be taken by the Forest Service in this country? There seem to be three alternatives:

1. Continue on about the present basis with some gradual extension of roads, trails, landing fields and other facilities, and about the present force of protection men.

2. If Congress can be induced to appropriate necessary funds, greatly intensify the protection set-up, open all the remaining inaccessible country with roads, and greatly increase the protection forces.

3. Set up a carefully defined unit of about two million acres as a low-value area which does not justify the cost of fire control. Maintain only existing roads and the major trails. Withdraw the entire fire-control organization and retain only a police force of two or three rangers to protect the game and direct recreational use.

The first alternative has been found by twenty years' experience to be practically useless. It has resulted in greatly modifying and to a large extent destroying the special values of a unique and distinctive wilderness area. The results in fire control have been almost negligible. Every really bad fire season has seen great conflagrations sweep completely beyond control, nullifying the results of every fire extinguished in the more favorable seasons. If I could show in color a map of this region with the area burned over since the beginning of national-forest administration, the country would be shocked at the lack of results for the millions expended.

116th Photo Section, Washington National Guard

Fig. 1.—Lochsa River Canyon as it appeared after the 1919 and 1934 fires.

116th Photo Section, Washington National Guard

Fig. 9.—Fish Creek after the 1934 fire. The Lolo Trail is on the high divide in the background.

The second alternative, a greatly increased intensification of protection, appears at least more logical than the first. We are now making vast expenditures with little or no results. To double or treble these expenditures and get the desired results would at least give the taxpayers something for their money. It would mean abandoning the wilderness area idea completely and opening the whole country with roads, but that has already progressed so far that there is really no wilderness left, and perhaps we might as well now make up our minds to an automobile recreational use of this area rather than a primitive pack-horse use, provided we are going to tackle the protection job.

The question then arises, even with the most intensive protection system conceivable, can the recurrence of such conflagrations as in 1934, 1929, 1919 and 1910 be prevented? The Selway country presents the toughest fire-control conditions of any area in the United States. There is a combination of a very dry, hot summer with the worst fuel conditions imaginable. The forest, in the lower country and along streams, is largely a cedar, white-fir mixture, much of it already fire-killed, and when a fire gets under way in such stands on a bad fire day, look out! Dry cedar, much of it hollow in the center, is an extremely light and inflammable fuel. The hollow trees carry fire like a chimney; the trees fall and shatter into kindling, and the kindling springs to flames. At the same time, shreds of dry cedar bark and sparks from rotten white fir snags throw fire to unbelievable distances ahead.

Can any conceivable system get the best of such conditions? In 1934 the four or five lightning fires which started in the lower Lochsa River presented as favorable set-up for fire-control facilities as the most fantastic conception of an organization would provide. The fires which did most of the damage started right under the eye of several lookouts. Thousands of men in blister-rust crews, road crews and CCC camps were working within a few hours' travel. An excellent road system traversed the area, making it possible to locate most of the fire camps on roads. In spite of the use of all these facilities and the rushing in of the best and most experienced fire overhead in the Region, four fires got completely beyond control and swept an area of 180,000 acres. If similar circumstances arose next year or ten years from now it is not at all likely that any different results could be secured in this particular country. I can only conclude that by doubling or trebling the past fire-control cost, the Forest Service might possibly reduce the area annually burned, but with always the possibility of a great conflagration sweeping beyond control and nullifying all past efforts.

Even assuming the practicability of a fair degree of fire control through greatly increased expenditures, is the game worth the candle? The Forest Service men are a tough outfit and it takes a lot to make them admit they are licked, but the amount of taxpayers' money involved is so great that no false pride or saving of face should prevent a scrutiny of the justification of maintaining such expenditure when weighed against the values obtained, even though it involves an admission of defeat.

Almost any forester or lumberman would agree that the character of tree growth, soil and topography on the area in question is such that there is little likelihood of its being developed commercially in the future, even under a period of considerable timber scarcity; and even though a few of the best areas should some time in the future be logged, the returns would at best be far below the annual expenditures, to say nothing of interest on past investment.

Recreational use and watershed protection are the only other values to be con-

sidered. It is conceded that these values would be enhanced by control of fires. However, the country in question in its natural state before the intervention of the Forest Service supported a fair forest cover and did not show any serious indications of watershed injury. Its special recreational values were probably greater than they are after thirty years of Forest Service management.

This leads up then to the third alternative of withdrawing all fire-control forces, stopping further expenditure for that purpose, and leaving the country pretty much to the forces of nature. It is a radical proposal, and could far better have been adopted ten years ago before the period of road construction started. Be that as it may, if a mistake has been made it is better to recognize it and change the mistaken policy than to plunge blindly ahead because a certain line of action has been started.

Much has been said and written about the abandonment of submarginal agricultural land. Should it not also be recognized that there is such a thing as submarginal forest land? Proper land classification and planning should lead us to radically different treatment of the wide range in classes of forest land. The good land will merit intensive treatment, the less good land less cultivation, and the least good lands something entirely different.

There has been enough money sunk, with little return, in the low-grade Selway wilderness to have acquired all the good cut-over and second-growth private forest land in Idaho, which is now a motherless orphan; and under present plans the Selway wilderness will annually swallow up enough funds for intensive management of these good forest lands.

Suppose the Forest Service should go to the proper committee in Congress and say, "We can save $300,000.00 a year by withdrawing from attempted protection two million acres of low-grade land in Idaho. Permit us to use this amount for the acquisition, management, protection and planting of two million acres of the best Idaho forest land." Wouldn't that sound like a reasonable thing to do?

The objection may be made that public opinion would not permit withdrawal of fire control from this area. Some day public opinion may rend the Forest Service for having accomplished so little protection with so much money. Public opinion can be moulded, and it is the job of foresters to lead public opinion in the right direction in forestry matters. Both as citizens and public officials it is the duty of the responsible men in the Forest Service to use the public funds wisely, and not to advocate expenditures that do not yield reasonable returns.

I am not advocating withdrawing protection from all low-value forest lands. It is conceded that it is a misfortune whenever fire sweeps any forested area, and while it is difficult to measure that damage in dollars it is certainly worth an expenditure within limits to prevent such fires. If the Forest Service could be assured of a reasonably adequate control of fire in the Selway country for two or three hundred thousand dollars a year I am inclined to believe that it would be worth while, even with little or no money return in sight. The trouble is that this country presents such an unusually difficult fire-control problem that even twice or thrice that amount will not insure any considerable reduction in the area which would burn without the attempted control, and a common-sense weighing of all factors indicates that it is time to withdraw from a losing game before more millions are expended with little or no results.

THE OPPOSITE POINT OF VIEW[1]

By EARL W. LOVERIDGE

INTELLIGENTLY to decide whether or not fire protection *is* impracticable requires, it seems to me, analysis of factors which have brought about the conflagrations which so many men have so often and so valiantly faced. For if past fire control policies and practices in this region are not, in every respect, true guides to such policies and measures as can and should be used, improvements are possible. And improvements, if possible, might conceivably dispel despair.

It is my conviction,—shared, I find, by others acquainted with the situation,—that past fire control policies and practices in the region under discussion *are not, in several vital respects, as adequate as they can and should be.* Specifically, I hold that:

1. Suppression techniques and practices were faulty at critical times in 1934, despite the fact that real progress has been made in the past.

2. Back-country fire control *policy* has been unsatisfactory for years; a fatal condition that could readily be corrected.

3. Resource values and possible losses due to fires in this region have not been fully recognized.

4. Costs of real protection in this country are justified by the true values.

Volumes, literally speaking, have already been written on each of these matters. And more volumes could be added. But consideration for fellow technicians, as well as lack of space, require at least *some* degree of brevity in the following discussion.

Suppression Practices

Koch speaks of having "as favorable a set-up for fire control facilities as the most fantastic conception of an organization could provide." Yet the records indicate many serious breaks on the large Selway fire of 1934 (which resulted, by the way, from the fusion of eight lightning fires). What were those breaks? Among others,—and without going into details,—an initial attack so sluggish that it required four or five hours in the "peak of the peak" of the fire season and in a locality where one hour for attack should be the maximum; poor predistribution of available man power; good intentioned, deliberate, but faulty non-manning of three sectors of the going fire. So that even though the "set-up" was present, *it did not function properly.*

Four or five hour control for this country is admittedly and fantastically ridiculous. And regardless of expenditures for roads and other physical improvements, an army of man-power (more than 2,000 CCC's were readily available) must be futile in emergencies unless it is handled with a reasonable degree of skill. This, true in military engagements, is equally true in fire control warfare.

Lest readers of the JOURNAL be led to incorrect conclusions, let me say, that in few places in the country can there be found a better selected, trained, equipped and organized body of fire control men than in the Northern Region. And they must, because they have (in places) about the toughest conditions imaginable to deal with. And no matter how good

[1]It is to be regretted that limitations of space precluded reproducing Mr. Loveridge's statement in full. It is to be hoped that deletions have not weakened the force which he wished to give to his argument.—Ed.

the organization, an occasional "break" is inevitable,—in any organization. The fact remains, however, that the serious breaks of 1934 were *not* "occasional." A "6-2-2-1" defense would have held them.

Fortunately, "breaks" in Region 1 have decreased during the past few years until, in 1934, only 9 per cent of its 1243 fires exceeded ten acres in size. The acreage burned in this Region during the past five years has dropped, as compared with the record for the preceding half decade, from .62 per cent to .39 per cent of the gross area within the national forests. These signs augur well for the future.

Additional belief that adequate fire control is possible at a reasonable cost in this country is based on the fact that there is a clear regional recognition that large fires are usually due to preventable weakness in organization, and that huge strides have been made. Fire control has reason to be proud, for example, of its special pumps, radio, trenchers, etc.; of wider and wider use of scientifically located fire breaks and detection improvements; of the development of better methods of determining and forecasting fire danger; of the more reliable gauges of the speed and strength of attack required for each situation. And even with these and other improvements, only the surface has been scratched.

Unsatisfactory Fire Control Policy

I understand that years ago Region 5 (California) enunciated a policy under which fires which started on alternate (or railroad) sections were to be "let burn," at least until such time as they seriously threatened federal values. I also understand that the policy was short-lived; far shorter, I believe, than that combined policy and objective—established for northern Idaho—which is based on the intention of holding costs plus the more tangible "losses" to a minimum.

This intention, however, laudable it may have been, has caused confusion and hesitation. It has amounted, in actual practice, *to lack of a clear cut, readily understandable fire-control policy for the "back-country" under discussion.* Imagine the effect on military field officers and troops under a similar handicap. Not being sure of their objective, a fatal hesitancy, a lowering of alertness, would be bound to result. It might be the reason why there were twice as many extra period fires in this Region in 1934, as in any other national forest region. Certainly it has been so in other regions; most recently in Idaho south of the Salmon River, where heavy losses resulted from attempts to follow the same questionable policy, and where the change to a positive policy which calls for prompt suppression of all fires, has been followed by a definite reduction (to the point of elimination) in the number of fires that are controlled only by heavy rainfall.

Resource Values and Possible Losses

Would that I might capitalize, in good hard dollars and cents, the sentiment engendered by such expressions as "the Lolo Trail is no more" and "gone are the camps of fragrant memory." In our attempts to be business analysts, we sometimes evaluate those resource values which call forth such sentiments at as much as 50 cents an acre. And then, in support of proposals of despair, we contrast fire expenditures on the Selway *with Selway cash receipts of* "only $76,000!" If this is our attitude, how can we expect the field men, backbone of the fire control organization, to have that pride of real service which is essential if they are to put their hearts into their efforts? The fact that many field men *do* have this feeling, despite their leaders' attitudes, indicates, perhaps, an underlying belief *on their part* that there *are* values—even though not yet expressed as high, dollars

and cents figures—which *are* worth protecting.

I firmly believe that returns in dollars and cents to the federal treasury via grazing and timber sales are *not* the only returns to be derived from publicly owned lands, despite the fact that we have, in the past, stuck to tangible, federal treasury dollars and cents figures in our attempts to lay down a fire control policy based on a theory that does not take all values into consideration.

Suppose there really were a huge "No Man's Land," a "Big Black Burn" within which it was known that the Forest Service was deliberately doing nothing in the way of protection. Would there not be a regiment of complaints, some based on fact, some imaginary, for permitting such a sore spot to exist? Would fishermen and hunters,—few now, perhaps, but more later,—be complaisant? Or might they be positive that fishing and hunting were not what they had been in the good old days? Might they, perhaps, conceive the idea that this back country ought to be developed as a wild life reservoir, to feed deer and elk to what is now more accessible and more intensively used country? And can it be so developed, if fires are allowed to run rampant?

Is free reign to be given to carelessness and wilfulness with cigarettes, pipes and campfires by hunters, fishermen, campers and grazing permittees who enter this area? Why not, if we are not concerned with fire therein? What understandable basis would we have for any other policy within the area? Would such a condition assist, or would it hinder, our 30 year struggle against carelessness and incendiarism in national forest areas some of which are separated from this "low value" area by a purely imaginary line?

Would those who hear about it, or visitors who might get no more than a long distance view of part of this area, recommend that a bureau with such evident lack of vision be given added appropriations? Or would they cry out at the shame and disgrace of it, and recommend a much needed shock: reductions; a new head; a shake-up; a transfer?

Values of such things as these may be intangible, but the things themselves—or their effects on our job, rather—are tangible enough. If we—or someone smarter than we—placed plausible dollars and cents values on such things, hope might, perhaps, replace hopeless despair in our consideration of a fire control policy for "back" country.

Travel by air is increasing. Indications are that it will be the common, rather than the uncommon, mode of travel in the future. What if the air is full of smoke? In addition, fire control men recognize another, and a most dangerous, condition chargeable against this factor. It is the lowering of visibility, often to such an extent that fire detection systems are seriously impaired and not infrequently put entirely out of commission. Those who were in the West in 1910, 1919, 1926, 1929 and 1933, when the great Tillamook fire occurred, will recall that detection systems were made useless or their effectiveness greatly lowered, not only in the regions immediately adjacent to the fires, but in sections of the country hundreds of miles away. Smoke from fires in Idaho obscured the Colorado Rockies during these years. Under such conditions, fires in the nearby high value country and in Oregon, Washington, California and elsewhere, may be expected to become unmanageable. There is nothing more useless than blinded lookouts and grounded planes. As for the timber (and other) values lost at these distant points, should they not also be charged against fires in the back country areas? Have such values as these been weighed in the balance by the "let-burners"?

It goes without saying that the values and influences of forested lands are dependent to a great extent on the size and

location of the areas involved. The burning of a small area in the back country would do relatively little harm. To be sure, Koch is not advocating withdrawing protection from *all* low value lands. "It is conceded," he says, "that it is a misfortune whenever fire sweeps any forested area—and it is difficult to measure that damage in dollars * * *." However, his proposal would directly affect "three thousand square miles." Others would as earnestly place seven thousand to ten thousand square miles or more,—from the Sawtooth mountains and the Salmon river to the Flathead, Blackfeet and Yak country in the northern part of Region 1,—in the same classification.

It is agreed that much of the timber in the section within which Koch and others would maintain devastation on a large scale because $76,000 does not pay all the costs, is small, scattered and relatively inaccessible. How many scenes of devastation,—"justified" by this argument,—are foresters now busily repairing? What effect might serious depletion of forest cover on even three thousand square miles of this country have on other values which can not readily be measured—values such as water supply, siltage, uncontrolled floods, and climate; intangible values in the areas immediately affected and in adjacent territory including the drainage of the Missouri, the Snake, and of Pacific coast streams?

Both the "Copeland Report" of the Forest Service (1933), and the 1934 report of the President's Water Resources Board, point out the high watershed value existing in the Northern Rocky Mountains. Both stress the need for better fire control because of damage done by forest fires to stream behavior, water supply, and erosion. Should any forester whose organization is founded on the premise of watershed protection fail to take them into account?

Is history to repeat itself to the shame of the profession? For years, many people in the Southwest laughed at those visionaries, there and elsewhere, who proclaimed the existence of overgrazing and who insisted that overgrazing was a primary cause of floods and erosion. Today, with the Roosevelt Reservoir partially filled with silt, foresters are frantically endeavoring to repair the damage. Efforts of many agencies and thousands of dollars are now being expended in corrective measures because the real cure of a few decades ago—the removal of excess numbers of stock—was not taken at that time because of powerfully adverse pressures involving the loss of a cash income of, shall we say, $76,000?

Two years ago a party of high ranking foresters visited the area it is now proposed to burn. There were some in the group who jeered the visionary idea that protection to the mountains was necessary because of the probability that some big reservoirs would some day be erected in the Northwest, yet dams are today under construction at Grand Coulee and at Bonnieville! Will not the foresters of a decade hence look back upon the present-day group and accuse it of destroying the treasure entrusted to foresters to preserve?

Furthermore, dare any forester sanely bring forth the idea of devastating an area as large as Delaware or New Jersey without considering what would be the effect upon the climate? The citing of actual records is unnecessary, but they are all alike in showing that a forest reduces the extremes of temperature and evaporation, and increases humidity. Will the contemplated devastation have a corresponding effect in the region lying to the westward? No one knows, but it is safe to say that those residents of the Northern Plains region who have suffered from the recent great drought will not look with complacency upon a deliberate effort to maintain denudation on a scale which has in it the possibility of making life more difficult than it is today.

Protection Costs

In considering costs in relation to the proposal to segregate areas in which fires will be allowed to run unhampered, it should be borne in mind that

(a) Expenditures listed by Koch are open to question. They are the total costs for the entire Selway National Forest, only a part of which is within the low value zone. Moreover, expenditures per acre for roads and other improvements are much higher, in the zone where timber values are high, than they are in the "wilderness" portion where such improvements are comparatively few. And during the last decade (prior to the fiscal year 1935) approximately 50 per cent of the total expenditures have been for improvements. As such, these improvements are water over the dam. No part of the initial costs can now be saved.

It should be remembered that "let-burners" would continue to maintain existing roads and major trails and would also continue an organization "to protect the game and direct recreational use." To any forest administrator acquainted with this proposed type of fire control, the 15c per acre which Koch feels could be made available for other purposes is obviously unreasonable. Where "controlled burning" has been tried in other regions, its cost has exceeded protection costs.

(b) A large portion of the "wilderness" does not possess a high fire hazard. Indeed, much of it is below the average degree of fire danger of many western types. Clumps of lodgepole or other species, with open spaces between them, are not uncommon. Protection in these sites is not particularly difficult.

(c) The areas of high fire danger are almost entirely outside the back country. And it is in high danger areas that, despite more intensive protection there, many of the worst "back woods" fires have started. Tighten up on control in these high value areas and the cost of back country protection, even on the basis of continued drought conditions, will drop far below the figure which Koch believes is justifiable. And with a return of a wet phase (predicted by meteorologists) fire will, of course, be easier to handle and costs will be correspondingly reduced.

(d) Natural barriers to control such fires are practically non-existent. This has been demonstrated time and time again. For example, Howard Flint while on air patrol has noted—a thousand feet and more in the air—embers of flaming cedar bark two or three feet in length floating to unknown destinations. And local forest officers have repeatedly recorded spot fires five miles or more away from the original fire. The point to this is, of course, that fires can not be permitted to run as the "let-burners" propose, with the expectation that they can be held to any definitely segregated area. A fire utterly out of control cannot be stopped at a line between high and low values. It must be controlled while small regardless of location, otherwise, clearly tangible high values will also be destroyed.

A Suppression Policy

The principle that protection costs should bear a reasonable relation to values,—long recognized,—is sound and logical. It should be, now, as it has in the past, the cornerstone of our fire suppression policy. But if that suppression policy is to be equally sound, it *must give due weight to all values*, tangible and intangible, potential as well as immediate; must embrace the long-time, national viewpoint as well as the short-time, local one; must set up minimum protection standards which, even for minimum values, are high enough to prevent devastation.

Past experiences in the back country—on the Selway in 1934, and elsewhere—indicate that recognition must be given

to this fact that *no* protection is in too many cases *more costly than real protection.* It follows, then, that positive protection *must* be given in some degree to even the lowest of national forest values if they (and adjacent higher values) are to be saved from destruction.

There is a real lure in Koch's statement that his proposal is a "radical" one. A counter proposal should perhaps be equally radical. There might be suggested a policy based on the objective of "keeping every acre green." It is not advanced, here, because unvarying action is neither advisable or necessary if a minimum be set up and due weight given to all values. The approved principle that protection costs should vary with values can be applied, both to front and back country, with the certainty that adequate protection, rather than destruction, will result. For example, that in forests of highest value, whether tangible or intangible, advance preparations may include heavy expenditures for firebreaks subdividing the country into small blocks and that each fire will be fought by "direct" attack (at the fire edge) and held to the smallest possible size. In lowest value country, on the other hand, there may be a complete absence of such expensive improvements as fire breaks, and fire fighters may take advantage of the easiest nearby terrain from which to make their attack even though this may mean backfiring and the resulting deliberate burning out and sacrificing of relatively wide strips between the fire edge and the backfire line.

But in either case, facilities for, and execution of, prompt and decisive action is mandatory; in neither case should the disastrous "herding" or "let burn" policy be countenanced.

FOREST FIRE INSURANCE IN THE PACIFIC COAST STATES

By H. B. SHEPARD

U. S. Forest Service

Private capital must either be insured against risk or compensated for assuming it. Even with excellent forest protection the risk to private capital in forestry in comparison with probable returns generally remains so great that insurance would aid in interesting the investor in the forest business. Mr. Shepard herewith summarizes some of his findings of his painstaking investigation.—P. A. HERBERT.

THE principle of insurance has come, in modern times, to occupy an important position in an economic structure resting largely on the base of private property ownership.

Fire insurance, when it can be obtained in satisfactory form and without excessive cost, is in definite demand. Owners are willing to go to considerable pains to maintain what they consider adequate insurance on their properties. Without some such form of reserve the economic status of private property would unquestionably be seriously impaired. The carrying of insurance is the best method so far devised of maintaining reserves against contingent fire loss since it gives each owner the benefit of the law of large numbers. If a class of property is not afforded adequate and practical fire insurance facilities, it suffers definite economic inequalities which inevitably exert an adverse influence on its management.

Where adequate fire insurance facilities do not exist at the present time the fact can be attributed to one of two reasons. Either conditions are prohibitive to the application of the insurance principle or the facts are imperfectly understood.

Forest properties are among those which do not enjoy adequate and practical fire insurance facilities. To the extent that this is an adverse economic influence, good management is handicapped. It is well understood that good management of private forest properties suffers from other handicaps as well. Nevertheless, the lack of fire insurance is an important one and its removal could be counted upon to aid in the effort toward improvement.

The forest insurance study, so-called, authorized by the Clarke-McNary law and conducted by the Branch of Research of the Forest Service, has been directed toward determining why the owners of forest properties do not enjoy fire insurance facilities comparable to those afforded other owners and whether means could not be devised for effecting practical and economic forms of insurance cover for them. Begun in the Douglas fir region four years ago, this study was later extended to the northern ponderosa pine region of eastern Oregon and Washington, central Idaho, and northeastern California, the sugar pine-ponderosa pine region of the west side Sierra in California, and the redwood region.

The conclusion is that the lack of fire insurance facilities is due more to imperfect understanding than to prohibitive conditions and means are accordingly suggested whereby the situation might be improved. There is no apparent reason why successful forest fire insurance should not be possible in this territory as far as the loss situation is concerned. There do not, furthermore, appear to be any insuperable underwriting or administrative difficulties. Technical problems are no greater than those that have been successfully met in many lines of endeavor. On the basis of the conclusions of the

study it is safe to say that forest fire insurance can become a fact in the territory at the moment that, for any reason, it becomes necessary, or when the forest owners really want it. Furthermore it can be supplied at a cost comparing very favorably with the cost of fire insurance on other forms of property.

This territory contains approximately two thirds of the privately owned, merchantable size timber in the whole country and extends over a great geographical range. It thus offers in itself opportunity for the operation of the law of large numbers sufficient for sound underwriting practice and consequently can support a forest insurance project without regard to the rest of the country. Obviously, as greater aggregate property values could be actually insured, lower premium rates could be offered, better policy terms could be granted, and the prospects of success improved. In the absence of any real indication, particularly under existing economic conditions affecting timber ownership and the lumber business, as to the amount of forest fire insurance business that might be done, recommendations have been made for practice providing a certain amount of business could be obtained. The rates suggested assume a premium income of from $150,000 to $300,000 per year.

The prospects of obtaining this volume of business with adequate spread of liability could not be determined short of launching an actual insurance enterprise or conducting a detailed inquiry partaking of the character of an extension phase of the project. It has not been believed that such an inquiry would be opportune until general conditions have become more stable.

As an indication that loss conditions do not preclude an insurance practice on a basis economically favorable to the property owners, the following determinations of the study are cited. The average annual net loss expectation for the Douglas fir region as a whole, after salvage, from ordinary fires, is 0.047 per cent, that is, on a unit value basis four and seven tenths cents per $100 per year. The corresponding figure for the northern ponderosa pine region is 0.119 per cent, and for the sugar pine region, 0.133 per cent. These are adjusted figures based on intensive analysis of a 10-year experience, supplemented by extensive study of the data for the previous decade. In an entirely proper sense, they express the average of a 20-year experience.

The pine regions disclose no evidence of any hazard from major conflagrations. The figures quoted above can, with the exception of proper allowances for indeterminate contingencies, be taken as representative of the total of hazard. The Douglas fir region, however, is definitely known to suffer heavy major conflagration losses that do not necessarily fall within the experience of a 20-year period. The great Tillamook conflagration of 1933 is illustrative of what is meant here. It demonstrates definitely that the hazard still exists, but it was 31 years since the region had had such a fire. Introducing allowance for this factor into the figures brings the annual loss expectation for the fir region up to a figure somewhat higher than is indicated for the pine regions, that is, to 0.140 per cent.

The redwood region is, to all intents and purposes for the insurance study, an extension of the Douglas fir region in which occurs, along with the others, a species of great economic importance. Proper allowance for variations, of which the low susceptibility of mature redwood to fire damage is the most important, is essential.

These loss figures indicate the practical possibility of conducting a successful forest fire insurance undertaking at an average annual premium rate of close to one quarter of 1 per cent if all, or nearly all, of the private forest property in the territory could be insured. This is with

the ordinary allowance for expense ratio[1] in the fire insurance business. Obviously, the less business done, the less opportunity is afforded the law of large numbers for effective operation and the greater the need for factors of safety against unknown and indeterminate contingencies.

The method adopted by the study for getting around, for the present, the uncertainty as to how much business could be done was to construct a proposed schedule of premium rates that it was believed would fulfil the requirements on the basis of the accomplishment of the volume of business suggested above. These rates, averaging 50 cents per $100 of value (one-half of 1 per cent) for the Douglas fir region, 40 cents for the northern ponderosa pine region, and 35 cents for the sugar pine region, give an average for the whole territory of 45 cents. These are 100 per cent coinsurance rates.[2]

Unquestionably a few years of favorable experience, with a showing on the part of the owners of a desire to support insurance on a large scale, would justify a material reduction of this proposed rate level. How soon it might be possible to reduce it to the pure level of the aggregate average can not be predicted. A large volume of well distributed business would be an indispensable requirement.

The problem of making the premium rate a practical expression of variable hazard is one toward which the major activities of the inquiry was directed. Forests, like other forms of property, exhibit wide variations in net fire hazard, due to the influences of a large number of hazard factors. This work involved a complex problem in multiple correlation with a large number of independents. The most practicable method of solution entailed the separate study of each, making rational interpretation where available statistical data were inadequate, and building the component scale of hazard variation, factor by factor, expressed in terms of the perfect fire risk, in which hazards are irreducible. The rate schedule was then evolved, giving consideration to practical requirements not expressed in an impartial measurement of hazard variation. The scale of variation of hazard, for example, is much too wide for practical use. The scale of premium rates must run through a considerably narrower range if it is to serve a truly practical purpose. This necessity is imposed partly by inescapable requirements in practical administration and partly by general principles of equity in the distribution of services.

To illustrate the wide range of hazard itself, as disclosed by the statistical studies, a property in the Douglas fir region fully exposed to unburned slash hazard is, other things being equal, 65 times more likely to suffer fire loss than a property not so exposed. In the northern ponderosa pine region, a property within one mile of the edge of the desert incurs an increase of hazard of 10 times as compared to an exactly similar property well back in the timber. In the latter case the increase is evidently due partly to drier conditions prevailing on the desert fringe and partly to a more adverse wind condition. Theoretically, rates in the Douglas fir region can vary all the way from two and one half cents per $100 per year, the arbitrarily adopted basis rate, to $62.82. It is extremely unlikely that any properties actually exist in the field that are such ideal risks as

[1] The portion of the premium income that is used to pay the expense of conducting the business. (40 per cent of premium.—P.A.H.)

[2] Rates granted when the policy states that, in event of loss, the insurer is liable for no greater proportion thereof than the amount of insurance carried bears to 100 per cent of the actual value of the insured property.

to take a net rate of two and one half cents. Obviously one so practically certain to burn every few years as to be rated at $62.82 would soon cease to possess an insurable value. These extremities of range are none the less essential to the rating method, which must provide for all recognizable contingent variables. Adverse factors are never entirely absent. Neither are they ever 100 per cent present in a given area.

The variable factors of hazard that were used are, in principle, similar in all the regions studied, though not all factors carry significant influence in all regions. If a factor operates to only a minor extent or its range of variation is very narrow, no differentiation is made with respect to it in recognition of practical requirements of simplicity. No over-complicated schedule could succeed in the true sense.

Broadly speaking, all variable hazard factors fall into one of two major classes, causative hazards which start fires, and contributive hazards which influence their spread or the extent of their damage. To avoid undue length, only a few of the more important hazards that were identified by the study and incorporated into the schedules will be mentioned.

Among the causative hazards are lightning, railroads, recreation, and logging. The study of causative hazards is a map study, location being the essential medium of correlation. Variable causative hazard is expressed in number of fires (from a cause) per unit of area. In application lineal distance is the factor used. The hazard arising in a given unit of forest area from a railroad, for example, is a function of the number of fires per unit of area started by railroads combined with the distance between the area and a railroad. Some causative hazards, as lightning, or recreation, cannot be associated with definite points or lines but must be handled through the delineation of zones in which they are found to operate or, practically speaking, not to operate.

Contributive hazards divide logically into three main classes, physical hazards, climatic hazard, and protection. Protection is essentially a negative hazard in that it decreases the likelihood of loss. The adoption of the customary insurance practice, however, of establishing a standard (the best) and providing for measurement of deficiencies below the standard turns the effect around. Deficient protection is a positive hazard. By holding the appraisal of the value of protection to an absolute basis rather than a relative one, its true place in the structure is preserved. The best protection, expressed in the absolute scale, is often provided where other hazard conditions are worst. Good protection is not always, therefore, associated with low losses. A properly constructed insurance rating schedule provides for the correct measurement of the final component.

Among the physical contributive hazards that were identified and made use of are composition and density of the stand, slope of the terrain, snags, and unburned logging slash. A stand of trees easily killed by relatively light fire is more hazardous than one composed of more resistant species. This is the factor of susceptibility. Under certain conditions fire maintains great destructive capacity in dense stands but tends to fray out in sparse stands. Where this is true heavy density is a physical contributive hazard. Under other conditions the dense stands, by helping to retain moisture, may be less hazardous than the more open stands. In some types of forests, therefore, the evidence indicates that the moderately dense stands are the most hazardous. Snags commonly increase hazard by raising the intensity of combustion and sending out brands. The effect of logging slash on forest fire hazard needs no general comment.

With the exception of the study of

climatic hazard, which is inevitably a map study, and the development of provision for allowance for variation in protection, which is largely a matter of practical experience, the study of contributive hazards is essentially statistical analysis. The statistics used specifically for this part of the study were, in part, collected by the study itself in the field through a field analysis phase embracing upwards of 70,000 acres of insurable fire-damaged forest property, and in part contributed for this special purpose by state and association fire wardens who furnished detailed information on upwards of 1,500 individual fires over a period of five years.

It was recognized early in the development of the study that the factor of loss was not the only one of importance to the possible introduction of the insurance principle to forest properties. Even though the loss situation might prove encouraging there was possibility that the prospects of successful operation might be diminished by the influence of other factors. Study was accordingly made of the apparent requirements of forest valuation for insurance purposes, of the special principles of loss adjustment, policy contract requirements, and other administrative features. No difficulties greater than some others that have proven surmountable in both the insurance and the timber business were disclosed. When forests burn, for example, it is often very difficult to appraise accurately the loss in value. The problem is not clear-cut like that of the loss of, say, an automobile, the market value of which is always a quite definitely established figure. Fire insurance has already had a great deal of experience in dealing with losses the appraisal of which is difficult and complicated. The principles of forest valuation have come to be much better understood in recent years than they were formerly. There is no reason to fear prohibitive difficulties in this regard.

Space is lacking for any substantial discussion of desirable policy contract provisions further than to say that no radical departures from established practice will be required. The application of the co-insurance principle will be indispensable and, during the early stages, at least, it will be advisable to limit liability to three quarters of the value at the most.

Several innovations are suggested for loss adjustment in forest insurance as compared to general practice. Because of the difficulty usually experienced in determining the exact effects of fire in forests immediately afterward it is suggested that at least a year elapse between the time of the fire and the adjustment of the loss. It is also suggested that all losses be adjusted by three arbitrators, as is done in Norway. One arbitrator is chosen by the insured and one by the insurer, these two choosing a third. Their findings are binding on both parties. It it believed that forest fire adjustments will be made more economically and effectively if this method is adopted as standard. A progress report is in process which gives full discussion of all these features. It also discusses the various forms of insurance carriers, stock, mutual, reciprocal, government, etc., in their apparent relationships to possible forest insurance.

It may be advisable, before closing, to take time for a short discussion of one feature of fire insurance that is, to some extent at least, misunderstood. The writer has often heard the opinion expressed that if insurance is introduced the protection program will suffer. The theory is, of course, that the owners will tend to be more indifferent to fire loss and to withdraw support from the protection effort.

The answer to this is that, however plausible this theory may appear, insurance nevertheless cannot function that way. No decrease in the responsibility for the maintenance of good protection

ensues when insurance is introduced. The responsibility is merely shifted from the shoulders of the owners to those of the insurance carriers. As evidence of a natural desire not to be separated from their funds to undue extents, these carriers display an active interest in the maintenance of good protection. Being well equipped, with both practical experience and technical knowledge, to deal with protection matters and being well organized for concerted action, they can properly be expected to preserve a condition under which protection is more likely to be strengthened than weakened.

It is believed that the study has been able to analyze all of the significant factors possibly affecting a forest fire insurance undertaking with the exception of the all-important one of the possible amount of business. What will be done about this it is not possible now to say. There can be no question but that the most pleasing and satisfactory result of the study would be the development of an actual practice based on its findings. This may, possibly, take place of itself. More likely some extension work will be required. In any event the outcome is mainly in the hands of the owners of the forest properties. By far the most important single requirement for successful forest fire insurance is an indication, on their part, that they would supply a considerable volume of business. It can very reasonably be expected that unmistakable evidence of such a disposition would be met by the offer, in one form or another, of sound insurance facilities.

It is the task of the forester to maintain and develop the most profitable forms of trees and forests, and to see that the forest is kept in full work, always and everywhere, so that light and soil, heat and moisture are never wasted.

The axe is his most important tool. With this tool the tree-form and the forest-form are very considerably influenced, if it is done at the right time and in the right way. "At the right time" is from the time when the young plants are 1-2 m. high and throughout the whole period of stem cleaning; "In the right way" is by frequent and careful thinnings (every 2nd-5th year), the most important thing being first and foremost to help the best and largest trees rather than to remove the bad.—*Scottish Forestry Journal.*

THE SHADE TREE EXPERT

By R. R. FENSKA

The F. A. Bartlett Tree Expert Co.

Culture and leisure have brought with them a new occupation. Mr. Fenska describes some of the problems that must be solved by trained men engaged in creating and preserving the aesthetic use of trees.—P. A. HERBERT.

TWENTY-FIVE and thirty years ago, when the forestry schools in this country were just beginning to send out their graduates, the care and preservation of shade trees did not offer much of a future to the forester. This kind of work was then mostly in the hands of the so-called "tree-doctor" or "tree-surgeon." The forester was inclined to look upon this phase of tree preservation as more or less superficial in character and even considered some of it within the realm of quackery. That such opinions were justified in many cases there can be no doubt. At that time the public was not especially "tree conscious" and therefore placed little value on shade and ornamental trees. In recent years, however, the average home owner has come to appreciate the aesthetic and monetary value of his shade trees and is willing to pay for their proper care. The result is that the itinerant "tree-doctor" is now rapidly being replaced by the shade tree expert,[1] or arborist, who has the proper training and experience for this kind of work.

The purpose of this article is to set forth the scope and activities of the shade tree expert so that any forester who may contemplate entering this field will have some idea of its nature and possibilities. Until our colleges are ready to offer a definite curriculum for the training of the shade tree expert the forester is the one best prepared to take up this activity.

To those who have not kept pace with the progress made in recent years in the scientific study of shade and ornamental tree care it may surprise them to learn that there are now engaged in this work some of the outstanding scientists in this country. The large commercial tree expert companies are at present using all available scientific data in their diagnosis of tree trouble. It is their policy to have in their organization men who are specialists along certain lines, such as the entomologist, pathologist, physiologist, fertilizer expert, etc., to help the tree expert in the correct diagnosis of all tree trouble. No one man has the knowledge to diagnose and prescribe for all tree ailments but the sum total opinion of such a group of specialists cannot but help point towards the correct solution, be the trouble what it may.

Although the forester today is the best trained man to take up the activities of the shade tree expert he is by no means qualified to step into this field without further training. The foresters who are now engaged in this work will readily admit that certain courses in their forestry curriculum have been of great help to them, especially plant physiology, dendrology, entomology, and pathology. These have been the "rock foundation" that have given them the confidence to take up the work. Sooner or later, however, they have found it necessary to enlarge their knowledge quite considerably even in the above mentioned subjects, to say nothing of taking up entirely new ones. This is apparent when we con-

[1] The writer prefers the designation "Shade Tree Expert" at present rather than "Arborist" because its meaning is more generally understood by the public.

sider the work of the forester versus that of the tree expert.

The forester usually looks for his results in the future while the tree expert must produce them within a comparatively short time. The forester knows the native trees of his region but the tree expert must also know all the exotics and horticultural varieties. The latter are often of more importance than the native species. The forester is chiefly concerned with the inter-relation of tree growth (the forest) while the tree expert looks upon trees as single specimens. The forester is seldom in a position where he can combat forest insects and diseases in a direct manner whereas the tree expert always uses direct means of control, if such a control there is. The forester has seldom available the necessary funds for the proper maintenance of his forest but for the shade tree expert amounts can be had for single trees that would suffice for acres of forest growth. Thus it will be seen that the work of the shade tree expert is far more specialized and intensive than that of the average forester.

The value of shade trees to the urban and especially the suburban home owner is responsible for this. It requires a good sized elm or oak in the forest to have a stumpage value of five dollars, but the same tree on the average estate and in a desirable location would be worth a hundred times this amount. Such values justify the intensive care now given our shade trees. Often there is a sentimental or historical value placed on certain trees that is even greater than their aesthetic value. It is not difficult to understand this.

The work of the shade tree expert may be grouped under the following activities:—

1—Pruning and trimming.

2—Treatment of wounds and cavities.

3—Spraying for insects and diseases.

4—Cabling and bracing structurally weak or damaged trees.

5—Feeding trees.

6—Treatment of roots.

7—Special treatments, i.e. removal of borers, installation of lightning protection, etc.

8—Removal and moving of trees.

9—Consultations (appraisal of damage to trees, gas injury, planting advice, etc.)

Pruning and Trimming.—Pruning consists of the removal of dead, diseased, and interfering branches. The flush cut is the basis of all pruning and trimming operations. If a stub is left it will die back to the next fork below and eventually leave a decayed spot at that place. Although this principle was established as far back as the time of William Forsyth (1737-1804), "Gardener to His Majesty King George III," one can today walk along most any of our residential streets and see fine shade trees improperly pruned. If left in such a condition it is usually the beginning of the end. Trimming includes the removal of storm damage in the crown and any live branches necessary to shape up the general appearance of the tree.

The scars caused by pruning and trimming operations must be painted with a tree wound dressing, usually called "tree paint," to prevent decay from starting at such places. Such a tree paint must not contain any ingredients which will kill back the cambium and thus cause loose bark around the scar. It should also be antiseptic in nature and not so impervious to moisture that sap cannot slowly escape through the wound. Otherwise it will blister and peel off. To reduce excessive checking of the surface of the scar the paint should be of a kind that will dry slowly. Season checks permit the entrance of spores of rot producing fungi. While a fairly satisfactory tree paint is now available the ideal wound dressing is still to be found.

Treatment of Wounds and Cavities.—This includes the treatment of all wounds

which require more than just an application of tree paint. The simplest wounds are those where the bark only has been injured and the sapwood exposed. In such cases a bark tracing followed with an application of tree paint is all that is necessary. The wound should be repainted as often as necessary to keep out rot producing fungi. The term "bark tracing" means that the bark is cut back to live cambium and the wound outlined, that is, "stream-lined," so the callus growth will close the injured part with new bark in the shortest time possible.

In the case of cavities which require a filler to replace decayed wood the first question is,—Does the physical condition of the tree justify the cost of a permanent cavity job. If not, the wound is cleaned out, shaped up for proper healing and drainage, and a wound dressing applied to retard further decay. In the course of time however such an open cavity will develop season checks and although several applications of tree paint may be applied decay will eventually appear in back of the paint. It is therefore at best only a temporary treatment.

If the cavity is not a serious one and the tree is still in a thrifty condition a permanent filling may be justified, especially if the decay is caused by the so-called "wound fungi." All that is necessary is to seal up the wound with a suitable material so the air cannot get at the wood surface and thus stop further decay. Callus growth will eventually close the injury with new bark.

Spraying for Insects and Diseases.—Two things must be kept in mind when spraying shade trees,—

1. What *kind of a spray mixture* is necessary to control or eliminate the insects or diseases attacking the trees.

2. *When* should this mixture be *applied* to the trees.

It is just as important that the spraying be done at the proper time as to have the right ingredients in the spray solution. In the past a good deal of spraying consisted of merely "white-washing" the foliage of the trees, or applying the mixture at the convenience of the person doing the spraying. This, of course, has resulted in the waste of a good deal of money and in some cases has been harmful to the trees.

One must be able to identify the insects and diseases attacking the shade trees and know the life history of each in order to be able to prescribe a proper spraying schedule. Sometimes a great deal of experimentation is necessary to determine what spray will control the insects and diseases and yet not injure the particular species of trees on which they are found.

Cabling and Bracing.—The proper installation of cables in the crown of structurally weak or defective trees or the reinforcement of split or weak crotches with wood screws has saved many a fine shade tree from damage by storm or ice. Such reinforcements in trees must however be made in accordance with the principles of mechanics and future growth of the tree. It should also be as inconspicuous as possible.

Feeding.—The average shade tree is located where it is a constant struggle for it to obtain sufficient moisture and some of the necessary plant food elements to sustain a normal growth. It is the function of the tree expert to determine the trouble in each particular case and prescribe accordingly. A knowledge of commercial fertilizers, or tree food, and the effect of the different elements on tree growth is necessary.

Root Treatment.—Girdling roots are sometimes the chief source of shade tree trouble. If they are not removed a tree so affected will gradually strangle itself to death or commit suicide. When discovered in time and carefully removed little or no injury will result. The roots of trees are also sometimes attacked by certain types of fungi which may prove

very injurious if no attempt is made to control their influence on the tree. The tree expert must know the symptoms of such trouble and suggest a remedy.

Special Treatments. — Special services which the shade tree owners sometimes request is the protection of valuable trees against lightning, removal of borers from infected trees, protection against winter injury, treatment of slime-flux in certain trees, and so forth.

Removal and Moving Trees.—The removal or taking down of shade trees in dangerous places requires trained men. The moving of large trees calls for special equipment to handle them. The size of the tree which can not be moved is only limited by the width of the streets and overhead interference such as wires and bridges.

Consultation. — Consultations and reports on all kinds of shade tree problems such as, planting advice, appraisal of damages to trees hit by automobiles, and gas injury damages are all part of the work a shade tree expert may be called upon to perform. This requires a broad training and experience for he must be prepared to substantiate and defend his findings in court.

To carry out the varied field work outlined above requires specially trained workers. These are the dendricians—or tree workers—who hold the same relation to the shade tree expert that the forest ranger does to the forest supervisor. The dendrician may be required to serve three years as an apprentice during which time he receives both classroom and field instructions. The large commercial tree expert companies now maintain their own schools for the training of these dendricians. They receive instruction in such subjects, as—

1. Identification of the common shade trees.
2. Identification of the common shade tree insects and diseases.
3. Mixing and applying spray solutions and the operation of power sprayers.
4. Treating wounds and filling cavities.
5. Pruning, cabling and bracing.
6. Feeding trees.
7. Removal or moving of large trees.
8. Use of ropes and different knots for climbing trees.
9. Use of special power tools.
10. Installation of lightning protection in trees.

Many a forester today feels he knows more about silviculture than there is an opportunity to apply it. The shade tree expert, however, has all the opportunity today he desires for the application of his knowledge in the care of the shade trees of his clients. His chief problem is to educate the average owner of shade trees as to what constitutes scientific or professional tree service and what is merely an amateur imitation.

EDUCATION IN FOREST ECONOMICS[1]

This report emphasizes the broad scope and basic importance of forest economics. It recommends more adequate training in this field for the general practitioner, but discusses chiefly the preparation of specialists. These, the committee believes, should have a training in forestry approximately equivalent to the bachelor's degree plus graduate training in economics, with emphasis on its application to forestry. A tentative program of studies leading to the degree of Doctor of Philosophy is suggested, although it is distinctly stated that "conditions and needs at different institutions and with different individuals vary so widely as to make any arbitrary or inflexible standard both impracticable and undesirable." Stress is laid on the need of fellowships for graduate students in forest economics.

FORESTRY rests mainly upon the triple foundation of biology, engineering, and economics.

Successful management of the forest is possible only with thorough knowledge of the individual plants and animals of which it is composed, and of their relations to each other and to their environment. Every forest is a living organism, the biology of which must be understood whether we are interested in it as a source of wood, of wild life, of beauty, or of other products and services.

Similarly, the orderly administration of a forest property requires the determination of boundaries, the preparation of maps, the construction of roads, trails, and fire breaks, and the building of cabins, lookout towers, telephone lines, and other permanent improvements. When the product harvested is wood, the forester must have sufficient engineering knowledge to select and operate the most suitable forms of logging and milling equipment. If he is to follow the product beyond the sawmill he must know the properties of wood as an organic material and how to modify these properties through such engineering processes as kiln drying and preservative and fire-retardant treatments.

Finally, all of these activities, whether they are concerned with the reproduction and growth of the forest, or with the harvesting and utilization of its products, must be directed with reference to their economic serviceability. Forest policies and forest practices, both public and private, have to do primarily with the production and use of wealth, and must therefore rest on a sound economic foundation.

We have been slow to recognize the interdependence of these three broad fields of knowledge, and to appreciate the fact that it is the economic approach which gives meaning and social significance to the biological and engineering aspects of forestry. Few will question the desirability of thoroughgoing research in such fields as silviculture, forest protection, forest zoology, logging and milling, and wood technology; but whether the information thus acquired finds its way into practice depends upon economic factors. Technically perfect methods of forest management and of forest and wood utilization will be used only if they pay. From the private point of view "paying" ordinarily means a net profit in dollars and cents; from the public point of view it means a net return in social income, including such services as prevention of erosion, regularization of stream flow, provision of recreational facilities, and stabilization of community development. Public forestry will properly include many activities that private owners could not afford, but these activities must find their justification in a social return that justifies the expenditure.

Forest economics is thus a field of basic importance and tremendous scope. It in-

[1]Report of a special committee of the Committee on Social and Economic Research in Agriculture, Social Science Research Council.

volves a whole series of interrelated problems dealing with the classification and management of wild lands and waters; with the production, harvesting, manufacture, and sale of plant and animal crops therefrom; and with the furnishing of a wide variety of social services. More specifically it deals with such subjects as land inventories; identification of marginal and submarginal lands; coördination of land uses; forest taxation and tax delinquency; forest insurance; forest credit; present and probable future needs for forest products; balancing the forest budget; competition with other materials; integration of related industries; mergers and other combinations in relation to the antitrust laws; wholesale and retail marketing problems, including transportation; interregional competition; exports, imports, and tariffs; economic organization and operation of forestry enterprises; costs of and returns from forestry practices; sustained yield as an economic tool; nature and value of the so-called intangible services of the forest, such as its influence on climate, erosion, the water supply, recreation, and community development and stabilization; relative advantages of public and private ownership; federal, state, and private policies.

The foregoing list indicates a broad interpretation of the subject of economics. It is in fact true that political science, sociology, and several other social sciences are also involved. They are here all called "economics," because economics is dominant among them.

Adequate programs of public and private forestry will be adopted only as the general public, timberland owners, wood users, and foresters alike appreciate their social significance and the economic problems which they involve. They will be successfully executed only when the forest practitioner is as well trained in the economic as in the biological and engineering aspects of forestry, and when the basic economic facts of which he must make constant use are supplied to him by the investigations of specialists in that field. It is with the training of forest economists, as these specialists may conveniently be called, that the present report is primarily concerned.

First of all, it is clear that the forest economist must, as the name implies, be well grounded in both forestry and economics. Secondly, if he is to be a specialist in fact and not merely in name, he must have a training equivalent to that required for the degree of Doctor of Philosophy. Few, if any, now meet these two basic requirements. Those who have become interested in the field from the forestry side are weak in economics, while those who have approached it from the economic side are fully as weak in forestry.

Actual experience with specialization in other branches of forestry indicates that it is essential for the prospective specialist to have a training in forestry approximately equivalent to that required for the bachelor's degree, plus graduate training in the field of his specialty (botany, entomology, zoology, economics, etc.). The latter should ordinarily cover two years of course and seminar work, and should be oriented so far as possible to indicate the application of the principles studied to forestry problems, some one of which will be dealt with in detail in the doctoral dissertation. Whether the doctorate is technically classified as being in "forestry" or in "economics," and whether the chairman of the candidate's committee is a member of the school of forestry or of the department of economics, will naturally depend upon the organization, facilities, and policies of the institution concerned. Whatever the arrangement adopted, it is essential that it provide for the active participation of both units in the outlining and directing of the candidate's work along the lines indicated.

The accompanying program of studies is therefore not suggested as a precise guide to be followed with exactness, since conditions and needs at different institutions and with different individuals vary so

widely as to make any arbitrary or inflexible standard both impracticable and undesirable. It is presented rather in the hope that it may be useful as indicating with reasonable definiteness the general fields of work that can advantageously be covered in most instances.

This program of training recognizes the fact that the specialist is, in the last analysis, interested in the solution of distinctively forest problems. He may carry on investigations of the most basic character in various phases of botany or zoology or economics, but his ultimate objective in so doing is to make possible the better handling of the forest or its products. For this purpose it is not enough that he know in a general way "what forestry is all about." On the contrary, an intimate acquaintance with the main branches of the profession and a full appreciation of the close interrelationships that exist between them are essential for any realistic or effective approach to his work.

This is perhaps particularly true in the field of forest economics, which cuts across every other branch of forestry. Not only does the adoption of some apparently desirable technical practice depend upon its economic feasibility, but the execution of an apparently desirable economic policy depends equally on knowledge of the technical measures by which it can be made effective. For example, suppose that the lumber industry becomes convinced that its only hope of salvation lies in putting a stop to "overproduction." Suppose further that careful study shows that the only permanently effective regulator of production is sustained yield forest management under which the annual or periodic cut of timber is limited to the growth. Installation of such management either for a specific tract or for the country as a whole is possible only with full knowledge of the present stand of timber, its rate of growth, silvicultural systems of cutting, logging methods, cutting cycles, and relative costs and values under different forms of management. It thus involves numerous and complex problems in such branches of forestry as mensuration, silviculture, utilization, regulation, and valuation.

The forest economist does not have to be an expert in all of these fields, but he does have to be sufficiently familiar with their content and technique to appreciate their relationship to the more strictly economic phases of any given problem, and to be able to interpret properly the data furnished him by specialists in other fields. This requires a broad training in forestry, accompanied of course by a training in economics sufficient to give him a thorough knowledge of economic principles and theory, and facility in applying the special knowledge and technique of the economist to forest problems.

The number of subjects that could advantageously be taken in a combined training of this sort is obviously very large, so large indeed that the average student will not be able to go much beyond those that appear to be indispensable. Differences of opinion will naturally exist as to what these are, not only in forestry and economics but in the broad field of prerequisite and cultural subjects.

Modifications both in specific subjects and in the order in which they are taken will naturally be made in accordance with the local situation and the interests of the individual student. For example, those entering college with a reading knowledge of French or German, or with advanced credit in chemistry or mathematics, can replace these subjects in whole or in part by electives. It is also assumed that the candidate will acquire facility in the actual handling of foreign languages by considerable reading in connection with his problem work and his dissertation.

The program comprises only those subjects that are regarded as essential to provide a sufficiently substantial foundation for subsequent specialization, and could obviously be expanded to advantage from the standpoint both of general education

SUGGESTED PROGRAM OF STUDIES LEADING TO THE DOCTOR'S DEGREE IN THE FIELD OF FOREST ECONOMICS

First Year

First Semester	*Second Semester*
English	English
Mathematics	Mathematics
Botany	Botany
American Government	American Government

Second Year

Chemistry	Chemistry
French	French
Economics (Principles)	Economics (Principles)
Surveying	Sociology (Principles)
Elective	Elective

Summer Session

Forestry Camp

Third Year

German	German
Accounting (Principles)	Accounting (Cost Analysis)
Dendrology	Wood Technology
Forest Mensuration	Forest Protection
Silvics	Silviculture

Fourth Year

Economic Statistics	Economic Statistics
Economic History	Forest Policy and History
Land Economics	Forest Economics
Logging and Milling	Wood-Using Industries
Forest Regulation	Forest Valuation

Fifth and Sixth Years

Course, seminar, and problem work of graduate grade in

Economic Theory (two years of work, but not necessarily in courses bearing that name)

Public Finance and Taxation

Money and Credit

Production Economics

Marketing and Prices

Forest Economics

Electives in International Trade, Transportation, Economic History, Labor, Business Cycles, Agricultural Economics, or other branches of economics: or in Political Science, History, or Sociology.

Seventh Year

Dissertation (Thesis)

and of professional training. In both economics and forestry the courses taken by the prospective specialist would be identical with those taken by other students in these fields, except for problem courses which would of course be fitted to the needs of the individual concerned. In many of the graduate courses in economics, however, it will be possible to make assignments of special reading and reports to individual students in such a way as to emphasize the application of the subject matter of the course to forestry problems.

Furthermore, it should be pointed out that nearly every course in forestry, properly taught, will contain some information of an economic character. Silviculture deals not only with the technique of improving and reproducing the forest, but with the relative costs of and returns from different methods of cutting. Mensuration should concern itself with the commercial value of the forest crop as well as the mere determination of volume and increment. Forest utilization is as much concerned with the economic effectiveness of different methods of logging as with their technical perfection. Regulation and valuation are primarily economic in character.

Everywhere, in the actual handling of the forest and its products, we find it necessary to consider the economic aspects of measures that are apparently desirable from the biological or the engineering point of view. Costs and returns, whether in goods or in services of one kind or another, are items that cannot be overlooked, and that should be given due weight in courses concerned primarily with methodology and technique.

At the same time there is a distinct need for at least one specific undergraduate course in forest economics that will integrate and supplement the economic material contained in other courses, and in so doing will give a broad and unified but at the same time a fairly detailed outline of the main economic problems involved in the management of the forest and the utilization of its products. At most schools the present work in forest economics should be materially strengthened, and, in the judgment of the committee, should be required of every student of forestry, irrespective of the field of his special interest.

In addition to its value to the general practitioner and to the prospective specialist in other fields, such a course should provide a foundation for advanced study in any one of the various branches into which forest economics can readily be divided. For example, such subjects as the economics of land use and forest production, marketing and prices of forest products, forest taxation, forest insurance, forest credit, international trade in forest products, and the relation between forest management and community development offer unlimited opportunities for further study. With the limited demand that there is likely to be, for some time at least, for advanced work in such subjects as these, it seems impracticable to offer regularly organized courses in them. The individual student who desires to go further will, therefore, have to do so through the election of problem courses in the fields of his particular interest.

As to the mechanics of obtaining the training required by the forest economist, no single method can or should be prescribed. On the contrary, the door should be left open for anyone developing an interest in the field, whatever may have been the direction of his approach. In other words, the content of the specialist's preparation is of more importance than the means of obtaining it.

The committee therefore presents the accompanying program of study not with any expectation that it will be universally followed, but rather in the belief that it is intrinsically sound; that it will meet the needs of a larger group than any other single program which could be suggested; and that it will serve as a useful basis from which to start in meeting individual needs.

In the first place, the majority of forest economists will probably be recruited from among those who have started to take a general course in forestry and have later developed a special interest in economics. This is primarily because the forester has a better opportunity than students in other departments to become familiar with forest problems and their economic implications, and is accordingly more likely to be attracted to this particular field. Slight modifications of the usual curriculum from the third year on, such as are included in the proposed program, are adequate to enable this group to specialize without weakening their basic training in forestry and without neglecting fundamental subjects in economics.

In the second place, the program can also be readily adapted to the needs of those who enter college with the expectation of taking a general academic course but who later become interested in forest economics. Students in this group can either shift to a forestry curriculum as soon as their new interest becomes evident or they can continue on to an A.B. or a B.S. degree, with a view to following this with specialization in forestry and forest economics. In this connection it may be noted that certain institutions now have arrangements by which individuals with high scholastic records during their first three years may register for their fourth year jointly in the arts college and the school of forestry, thus obtaining the degree of bachelor of arts at the end of that year and a forestry degree one year later.

In general the committee regards it as preferable in the training of a forest economist to develop the economics and the forestry aspects of his education simultaneously, rather than to attempt to superimpose either of these on the other. The proposed program does this more effectively than may be realized at first sight, since, in addition to the specific economics courses listed, practically all of the forestry courses contain a good deal of material of an economic character. The program also has the advantage of giving the individual who takes it a broad enough training in forestry to find employment in other branches of the profession in case there is no immediate opening in his specialty.

For the student who first takes a degree in economics and then decides to specialize in forest economics, rather radical modification of the suggested program will be in order. Such a student will already have covered in an elementary way most of the economics courses listed but will probably have had little or no contact with forestry, an understanding of which will have to be obtained by a certain amount of course work supplemented by outside reading. Because of the considerable number of forestry courses included in the type program, and because of the elementary character of some of these, it will hardly be either necessary or desirable to take all of them, and a choice will have to be made as to which can be eliminated with the least loss.

In this connection it may be well to emphasize the committee's conviction that native ability and industry are even more important in the training of a specialist in any field than are the mere following of a specified program of study and the taking of certain prescribed courses. The success of any attempt to equip students for leadership in forest economics will, therefore, depend less on the educational machinery adopted than on the character and ability of the men attracted to this field. Great care should be exercised to encourage only qualified men to undertake specialized training.

Undergraduate training of the sort that has been outlined can be obtained satisfactorily at any forest school of recognized standing where the subject of forest economics is adequately covered through a separate course in this subject and in connection with other related courses. Graduate training leading to specialization can, however, be obtained advantageously only

at an institution having a strong school of forestry, a strong department of economics, and a strong graduate school. In addition, the school of forestry should be so organized and staffed as to facilitate specialization along economic lines. Full cooperation between the three units mentioned is of course essential. Only a few universities now meet these criteria, and nowhere has this field yet been adequately developed. Concentration of the work at a few well-equipped institutions will be much more effective than to scatter it rather widely.

Special circumstances may occasionally make it advisable for a man with an adequate training in forestry to take his graduate work at a university which has no school of forestry but which is particularly strong in some phase of economics that claims his particular interest, as for example land use, taxation, insurance, international trade, or public regulation. In all such cases, however, the absence of a strong forestry faculty to participate in the direction of the work constitutes a real handicap.

Finally, it should be recognized that many valuable contributions to forest economics have been and will continue to be made by economists with no formal training in forestry, and also by foresters with little or no formal training in economics. The present discussion is not concerned with these men but rather with those who are still in the student group and who have become interested in forest economics as a field of specialization, whether that interest has developed from the economics approach or from the forestry approach, as is probably more apt to be the case. In either event it is believed that adequate training should cover approximately the ground indicated.

No accurate estimate can be made of the number of forest economists who are likely to be needed in the near future, but it is certain that this phase of forestry has as yet received far less attention than its importance deserves. The woods are literally full of economic problems of the first magnitude which can be solved only by painstaking study by competent men. A greatly expanded program of research in forest economics by governmental organizations, educational institutions, and private agencies is urgently needed. Adequately trained specialists must be educated both for this task and for the strengthening of forest school faculties in what is now one of their weakest spots.

At the same time it is doubtful whether the best men will be attracted to this relatively new field without more scholarships and fellowships than are now available. Full graduate training is a slow and costly process which few feel like undertaking without assistance, particularly in a branch of the profession where the demand for men is still uncertain. A limited number of fellowships, instructorships, and assistantships are available for graduate students in forestry and in economics at various institutions throughout the country, but none of these are specifically for students in forest economics, and most of them are available only for candidates for the master's degree. The National Research Council does not cover the field of economics, and but little assistance can be anticipated from the Charles Lathrop Pack Forest Education Board because of its broad scope and limited resources. Specific grants for doctorate students in this field are, therefore, urgently needed.

S. T. Dana, *Chairman*
C. H. Guise
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TIMBER STAND IMPROVEMENT IN THE SOUTHWEST

By G. A. PEARSON

Director, Southwestern Forest and Range Experiment Station

The creation of the C.C.C. and N.I.R.A. made available, almost over night, a volume of man-power for stand improvement work, which was totally unexpected and almost equally unplanned for. Here was an opportunity to make thinnings, weedings, improvement cuttings, prunings, on a quantity production scale—an opportunity which must not be fumbled. How the research and administrative foresters in the Southwest coöperated to meet the situation, is recounted in what follows.

UNTIL two years ago timber stand improvement in the Southwest had been regarded as possible of attainment only in the distant future. Thinning plots had been established by the Experiment Station with a view toward answering the many questions that would arise whenever cultural operations were undertaken on an extensive scale. No one thought that the results would be needed very soon. Almost over night the C.C.C. and N.I.R.A. made available for this work a volume of man-power surpassing the wildest dreams of silviculture enthusiasts. In the Southwest as elsewhere, forest officers felt unprepared to undertake immediately such a large cultural program. Results from a five-year record of thinning plots were not adequate nor had much thought been given to technique. Nevertheless, the work began simultaneously on seven or eight national forests in the spring of 1933, and now Region 3 has to its credit some 54,000 acres of improved young stands of ponderosa pine.

Methods

The first instructions, prepared by the Regional Office of Forest Management in coöperation with the Experiment Station and the Pathological Laboratory, were patterned on existing experimental plots, but with modifications designed to take into account more fully various factors such as fire, soil erosion, bark beetles and heart rot. Briefly stated, the object was to increase both volume and quality of merchantable timber yields. The means employed to attain this end were proper spacing, cleaning of the boles, and removal of defective, diseased and malformed trees. Crop trees to the number of about 80 per acre were pruned to a height of 17 feet where dead limbs extended to that height; other trees were pruned only to the height of 6 or 7 feet. On some areas all of the trees were high pruned. Slash disposal was varied according to local needs, being lopped, scattered, thrown into gullies, or in some instances piled and burned. As a precaution against Ips attack, stems over 4 inches in diameter cut during the summer months were partially peeled, leaving strips of bark not exceeding 2 inches in width. Peeling also prevents fruiting of the heart rot fungus, *Polyporus ellisianus*. Trees badly infected by mistletoe or heart rot were felled, as far as practical, but where eradication would result in opening up the stand too much it was not attempted.

In 1934, profiting by the preceding year's experience, the method was modified primarily with the object of lowering costs. Felling was limited to the release of crop trees and removal of diseased, unmerchantable and otherwise undesirable trees, and low pruning was discontinued. As in the preceding method, the number of crop trees was limited to 80 per acre. Theoretically, the spacing of crop trees

is 23 feet but in practice it will vary considerably, as determined by the degree of stocking and availability of suitable trees.

It is of interest to consider the relative merits of the two methods. The first, especially where all of the trees are high pruned, creates a pleasing, park-like effect. Some regard it as too artificial. These critics should bear in mind that the method works in harmony with the natural process of eliminating the weaker individuals and creating the long, clean boles characteristic of the primeval forest at its best. From the economic standpoint, however, the method is wasteful in that it releases and prunes more stems than can possibly grow to maturity. Since all the remaining trees are released more or less equally it is only a matter of time until a second thinning must be made. If the original thinning is heavy enough to preclude competition for as much as 30 or 40 years, the stand will be opened up too much to maintain good silvicultural conditions and encourage good tree form. The second method assumes that the released crop trees will gain such an advantage as to assure their dominance over the intervening unthinned groups which presumably will be subject to keen internal competition. This may not always work out well in practice for it sometimes happens that, in the absence of suitable dominants, the trees selected as crop trees are in the codominant class. From the silvicultural point of view, large limby individuals which are likely to crowd the crop trees should be cut; but the cost of limbing, slash disposal and peeling the bark may be prohibitive. Where logging operations are in prospect it may be advisable to leave such trees if they contain enough merchantable material to pay the cost of handling.

A third method, or modification of the second method, looking toward a further reduction of costs, is under consideration. It would reduce the felling of trees to an absolute minimum but would prune crop trees as in the other methods. Crop trees would be selected, as far as possible, from the dominant or isolated classes on the assumption that they will always remain dominant. In most of the small pole stands of the Southwest, even though fairly dense, there are enough dominants to provide 80 crop trees per acre. Occasionally a crop tree would have to be released, especially where dominated by larger inferior trees. Where several dominants occur in a group, one or more would be cut. Continuous dense, even-aged stands are clearly not adapted to the method, but in the Southwest they are the exception. The method does commend itself for the extensive areas of open second growth which needs little thinning but requires pruning to produce saw logs. The object is less to stimulate growth than to insure that the ultimate stand will be made up of stems of good form and merchantable quality. The benefits of pruning open-grown trees may be appreciated from the fact that 40 to 50 per cent of their merchantable volume is commonly in the butt log.

Experimental plots have shown a striking acceleration of diameter growth after thinning, but this increase is mainly in the smaller diameter classes, most of which will drop out of the race; the larger, dominant trees have also responded, but relatively less than the smaller ones because they were growing at a fairly good rate before the thinning. If a dominant tree is growing an inch in 8 years and increases to an inch in 5 years after release, the acceleration is worth taking into account if it continues over a long period of years; but if the acceleration lasts only 20 years the gain will be only 1½ inches. It is doubtful whether a release cutting which takes into account all silvicultural objectives will be effective in pole stands for more than

20 years, and if each operation costs as much as $10 an acre, repeated release cuttings at 20-year intervals will not pay unless it should happen that there is a market for the material removed. With a much lower cost, limited to pruning and removal of occasional trees, it is not impossible that repeated operations might pay for themselves by raising the grade of logs, even though the volume were not greatly increased.

Costs

Cost records based solely on acreage covered are misleading because of great variations in the character of stands, and consequently in the number and size of trees handled. Records by E. J. Dyksterhuis on the Lincoln National Forest in 1933 supply a basis for estimating costs on other areas. A plot of one acre in a fully stocked stand of ponderosa pine in Copeland Canyon was treated under the first method. The acre contained 1,636 trees ranging in diameter from 3 to 12 inches, including a considerable number of large wolf trees. Of the total number, 1,088 trees were felled, all of the remaining 548 were pruned to a height of 7 feet, and 80 of these were further pruned to a height of 17 feet. Because the work was done in winter the bark was not peeled. The operation consumed 40.5 man-hours of labor distributed as follows: felling 44 per cent, low pruning 16 per cent, high pruning 10 per cent, brush disposal (lopping and scattering) 30 per cent. The total cost including mess and supervision was $21.04. Expressed in number of trees per man-hour, we have, in round numbers, the following figures: felling 61, low pruning 82, high pruning 20, brush disposal 90. Obviously these figures will vary according to the size of the trees.

Under the second method, in which only crop trees are released, the labor of felling and brush disposal is greatly decreased but the cost of pruning crop trees is unchanged. If the Copeland Canyon plot had been treated by the second method, assuming that four trees on an average are felled in releasing each crop tree, the labor requirement would have been as follows:

Felling 320 trees	5.24 man-hrs.
Low pruning 80 crop trees	.98 man-hrs.
High pruning 80 crop trees	4.08 man-hrs.
Brush disposal	3.50 man-hrs.
Total	13.80 man-hrs.

The total number of man-hours is slightly more than one third of the number expended under the first method, in which the stand was thinned to more or less uniform density. On this basis, a fully stocked acre could be improved at a cost of $7.15, and on average extensive areas of broken stands there would be a further reduction of from 30 to 50 per cent; in fact, large areas on the Sitgreaves and Carson have been handled for $2 to $3 per acre. If the bark must be peeled, the cost will be increased; on the other hand, most stands will require the felling of less than four trees for each crop tree. On an acre representing the more open type of full stocking, only 102 trees were felled in releasing 86 crop trees. Seven dollars per acre, including bark peeling, is considered a liberal estimate for the average run of fully stocked stands under this method.

Economic Aspects

The economic side properly has received much attention in the development of stand improvement methods. Although the primary purpose of the C.C.C. and N.I.R.A. programs is employment, forest management has recognized from the start that if stand improvement is to

become a permanent practice it must be capable of financial justification. The question narrows down to this: Will the cost of cultural operations be returned by increased yields and stumpage values? Whether one should consider interest on the investment is a matter on which opinions differ, but all foresters will agree that the principal should be returned. With this thought in mind, stand improvement has been confined largely to cutover lands, reasonably accessible and of good site quality. Preference has also been given to stands in the small pole stage, on the assumption that the maximum benefit per unit of labor expended would be realized in stands of this character.

Unfortunately, we do not have exact figures for drawing up the desired balance sheet. The initial cost of stand improvement and ultimate yields can be estimated closely enough; but we do not know how many times the operation may have to be repeated or supplemented in the course of the hundred years or more in which the young trees are growing into merchantable size. Still more uncertain are future timber values. Let it be assumed that $15 is spent on a fairly well stocked acre in three or more operations in order to release, prune and maintain in a dominant position the desired number of crop trees over a period of 120 years. If the yield is increased from 10,000 to 15,000 board feet and the stumpage price from $2 to $4 per thousand, the returns will be increased by $40, or $25 above the actual outlay for cultural work. In other words, the principal, invested during an average period of 80 years, will be returned with slightly more than 2 per cent simple interest.

The above estimates of the superiority of improved over unimproved stands in this region are believed to be very conservative. On the majority of our present cutover lands, the trees now in the sapling or small pole stages, if left to shift for themselves, will yield practically no clear lumber; poor form will render many trees wholly unmerchantable, and heart rot will take an enormous toll. Unless economic conditions change in such a way as to greatly increase the margin of selling price over operating costs, it is safe to say that extensive areas of untended second growth in the Southwest can not be economically logged after the last of the original stand has been removed. Stand improvement will to some extent accelerate the growth rate of crop trees, and it will replace cull or low grade trees with merchantable trees, every one of which will contain at least one clear log.

Looking Toward the Future

Although the economic side is important, it is even more important in this stage to develop methods that are technically sound. That costly mistakes would be made was almost inevitable. But if we emerge from this experimental period with technically sound and efficient methods, an important objective, aside from the immediate one of employment, will have been achieved.

Conjecture necessarily plays a large part in the foregoing discussion. Many questions are arising which can be answered only by experience. To this end, the methods here described are being tried out side by side on substantial areas in the Fort Valley Experimental Forest, and intensive records are being kept on smaller plots. Under the second method of cutting, varying numbers of crop trees are employed. All three of the foregoing methods in pole stands have been essentially duplicated in sapling stands. On the Sitgreaves National Forest a series of plots in densely stocked seedling stands were thinned to different densities in 1926. These, in addition to a number of

thinning plots established from 8 to 10 years ago on the Coconino, Kaibab and Prescott, are expected to furnish information for the guidance of future stand improvement operations.

Summary

Timber stand improvement in Region 3 had undergone a more or less gradual evolution since its inception in 1933. The trend has been away from a general thinning toward special treatment of selected crop trees.

The method now in practice restricts felling to the release of crop trees and removal of diseased and otherwise objectionable individuals. Crop trees numbering about 80 per acre are pruned to a height of 17 feet if dead limbs extend that high.

A modification of the above method contemplates further reduction of felling by lighter release of crop trees and by taking full advantage of the occurrence of dominants in natural openings. It is especially adapted to open stands.

Because of the prevalence of limby boles among the dominants of second growth stands, stress is placed upon pruning. Pruning may be expected not only to raise the percentage of clear lumber, but also to increase the merchantable volume of saw logs by improving the grade of trees and entire stands which otherwise might not pay the cost of handling.

Conservative estimates indicate that judicious stand improvement applied to suitable stands and sites in the Southwest will return its cost with a low rate of interest.

Record plots have been established to compare results under different methods, and to answer such questions as how many crop trees are required, how much and how frequently should they be released, and at what age should stand improvement begin?

Further investigation concerning the commencement of vegetation and meteorological data are required, but as far as available information exists it would seem that each species of tree has an average temperature-constant which is necessary during its seasonal vegetative period. This period of average temperature is longer or shorter according as the tree is on its southern or northern limit. The effect of climate merely lengthens or shortens the period of vegetative activity, but the specific average constant of the tree is in no way altered. This has been called the vegetation therm by Prof. H. Mayr, who states that 14° C. is the constant for the larch, and probably also for the spruce. If such a figure could be fixed for all trees its value would be great, but this investigation necessitates further meteorological data and phenological observation.—*Scottish Forestry Journal.*

A MOVABLE, CONSTANT-ORIENTATION, LOOKOUT MAPBOARD

By L. H. REINEKE

Associate Silviculturist, Northeastern Forest Experiment Station

In the location of fires from lookout towers by means of alidade and map, there is always a possibility that the line of sight from a fixed map to the fire will be obstructed by a structural member (corner posts, etc.) of the lookout cabin. To avoid this, maps are sometimes mounted on boards which can be moved about the table top, orienting the map by pressing the board against strips fastened to the table top. Wear and loosening of these orientation strips and the possibility of not fitting the board to them properly contribute to inaccurate location of fires. A method of mounting mapboards, free of these disadvantages, is described below. This method was developed by the author while at the California Forest Experiment Station.

THE principle of the method is simple. In Figure 1, a plan view, T is the table top over which the mapboard M moves. A and B are two pivots fastened to the table top, and C and D are similar pivots fastened to the mapboard so that the distance between the centers of C and D equals that between A and B. L_1 and L_2 are two links of equal length connecting D to A and C to B. These links are free to rotate about the pivots. The center lines through the pivots form a parallelogram, since, by construction, $AB = CD$ and $AD = BC$. Obviously, as the links revolve, the interior angles of the parallelogram change, but AB remains parallel to CD. The original orientation of the mapboard thus is maintained for all positions of the links.

With complete freedom of link rotation it is obvious that the ends of the links will describe circles of a radius equal to their length. Concomitantly, any point on the mapboard, including the central point representing the lookout tower through which the fire-locating line of sight passes, also will describe a circle of link-length radius. If the link length is 6 inches, this central point can be placed in any position on a circle 12 inches in diameter without changing the orientation of the map. A displacement of 12 inches is usually sufficient to secure a clear line of sight past any structural obstruction of the lookout cabin.

Theoretically, a mapboard arranged as described would function perfectly; mechanically, it would be of little value. The leverage involved when the board was moved by force applied at its free end would result in large strains on the links and their bearings, requiring relatively heavy fittings to resist them. Accuracy would be greatest when the interior angles of the parallelogram are 90°, but when these angles are 0° and 180° any loose play in the fittings would permit an appreciable departure from the original orientation.

These disadvantages of the single parallelogram type of mounting may be eliminated quite easily by adding a third link, parallel with the other 2 links, mounted at the lower left corner of the mapboard (L_3, Fig. 1). This additional link gives 2 additional parallelograms, $EFCB$ and $EFDA$. Obviously, as parallelogram $ABCD$ narrows to the position of minimum accuracy, parallelogram $EFCB$ widens to its position of maximum accuracy. The only mechanical drawback to the 3-link assembly is the lack of support for the upper-left corner. The addition of a fourth link at this corner (L_4, Fig. 1) overcomes this fault and adds 3 more parallelograms, $GHDA$, $GHCB$, and $GHFE$. The group of 4 links constitute,

in effect, 6 parallelograms, as shown in Figure 1.

The error in such an instrument caused by play in the fittings may be computed easily. Assume a 20x30-inch mapboard with 6-inch links pivoted at the corners of a 14x24-inch rectangle, with a total loose play in the bearings of 0.20 inch. It can be shown that the maximum error occurs when the links parallel the long sides of the rectangle. In this position the maximum possible error is computed to be $\pm$ 0° 43′, and this error would decrease proportionately as loose play is decreased.

An allowance of 0.20 inch is exceedingly generous; one-tenth of this would be ample to cover both initial play and play due to wear. (Since the mapboard need be moved only when the line of sight is obstructed, the wear would probably be immeasurable even over a period of 15 to 20 years.) With an allowance for play of 0.02 inch, the maximum orientation error to be expected will be only $\pm$ 4.3 minutes, approximately. This is negligible.

The practical expression of this mapboard mounting may take several forms. Existing installations of fixed table and sliding mapboard may be converted easily by the addition of 4 links and their pivots. A satisfactory design for them is shown in Figure 2. The link *L* is a piece of 6¾″x¾″x⅛″ cold rolled steel with 2 holes drilled and reamed to 0.500 inch in diameter, spaced 6.0 inches center to center. Four are needed. The spacing of the holes need not be exactly 6 inches but *must be the same for all 4 links.* This is accomplished easily by drilling and reaming one hole in each link, then using a jig (Fig. 2) for drilling the second hole. The link is slipped over the piece of ½″ shafting *B*, mounted vertically in base *A*, and pressed against stop *C*. The jig is then clamped in the proper position to the drill press bed, a spotting tool or small drill is used for accurately starting the ½″ drill, and the second hole is bored. Each link can be bored thus without moving the jig. After drilling, these holes are reamed also.

A pair of pivots is required for each link. The table top pivot *T* (Fig. 2)

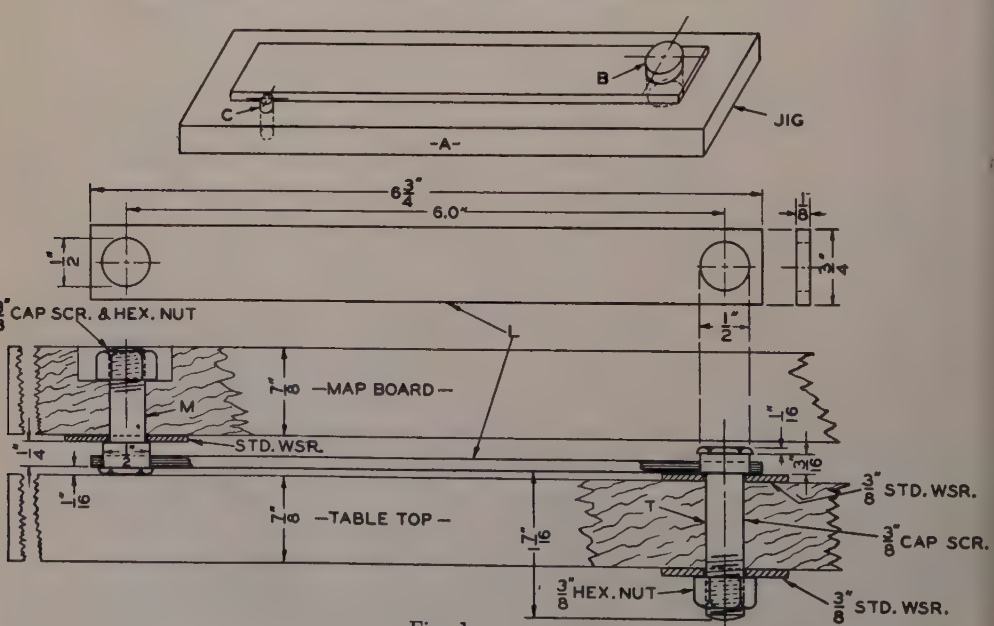

Fig. 1.

consists of a ⅜″ cap bolt, 2 washers and a nut. The inner 3/16″ of the bolt head is turned to ½″ round to fit the hole in the link, and the total length of the head is reduced to ¼″ to provide 1/16″ clearance of the mapboard. The washers are standard ⅜″, approximately 1/16″ thick. The mapboard pivot *M* (Fig. 2) is similar, but the head of the bolt is 1/16″ longer to produce the clearance between the mapboard and table top pivot. The shank of the bolt is also shorter, since the nut is recessed in the mapboard. An alternative construction may be used, omitting the threads on the shank, reducing their length to the thickness of the boards used and fastening by driving into tightly fitting glue-lined holes.

Installation is simple. The mapboard is centered on the table top, oriented and held firmly by cleats, clamps, or weights. A ⅜″ hole is then drilled through both mapboard and table at each corner of the mapboard, about 3 inches in from each edge. These holes must be as truly vertical as possible. Recesses are then chiselled in the top of the mapboard to receive the nuts, to eliminate projections above the map surface. A mapboard pivot *M* is lubricated with vaseline or grease, and a link is fitted to it. This is followed by a washer. The bolt is pushed into one of the mapboard holes from the under side. A nut is placed in the recess and turned down firmly. The recess for the nut is then filled in with putty or a plastic wood preparation. The remaining links are installed similarly.

The mapboard is then placed face up on the table, roughly oriented with the same edge toward the north as when boring the holes, and with the links extending outward at right angles to the long sides. The heads of the 2 table top pivots *T* are greased and placed in each of the bottom links. A washer is placed between each link and the table, the bolts are pushed through the holes in the table, and, after inserting washers, the nuts are put in place and tightened. The mapboard is then moved sideways and downward so that the bottom links rotate through about 180° and are covered by the board. The 2 top links are then fastened in place and the installation is complete, except for mounting the map in correct position on the mapboard. Installation of the threadless drive pivots is similar except that no recesses for nuts are needed, only one washer is required, and pivot shank and hole are both coated with casein glue before driving into place.

If the map is already mounted on the board, it will be necessary to slit the map at each mapboard pivot, along 3 sides of a square, lift the resulting flap, and fold it back during the installation. After installation the flap can be glued down in place again. As an alternative, the map can be punctured at the pivots and small patches, cut from similar sections of another map, pasted in place after installation.

For the link type of mounting, the table top should be larger than the mapboard,

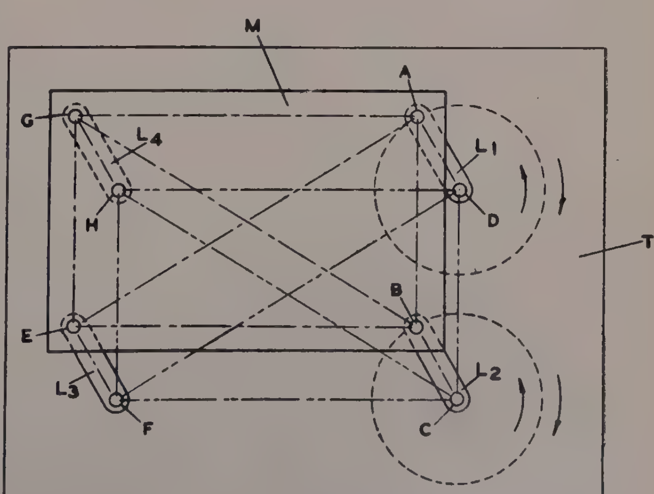

Fig. 2.

since the mapboard pivots M rest upon it. The minimum dimensions of the table top will be 2 (link-lengths plus radius of pivot head C) greater than the spacing of the pivots. Thus, for the 20x30-inch mapboard with pivots placed 3 inches from the edges, the spacing of the pivots is 14x24 inches. With a link-length of 6 inches and pivot head radius of 5/16″, the table top must be $14+2(6+5/16)$ by $24+2(6+5/16)$ or $26\frac{5}{8}$x$36\frac{5}{8}$. If the table top is larger than this, the pivots can be placed closer to the edges of the mapboard with a proportionate increase in accuracy of orientation.

A second form of mounting consists of 2 rectangular cast iron frames with vertical bearing holes at each corner, and double-end cranks to fit. These cranks are like automobile starting cranks, but with relatively short ends. One frame is fastened to the under side of the mapboard and the other to the table top. The bearings should match exactly when in this position. The bearings in the frame attached to the table should be at least one inch in diameter by 1½ to 2 inches in length. The mapboard frame bearings need not be more than ½″ by ½″. The large ends of the crank, extending downward, go into the frame attached to the table, the small ends, extending upward, go into the frame attached to the mapboard. To install, the mapboard frame is securely fastened with screws to the under side of the mapboard. The table frame is then placed in position, the cranks inserted in their bearings, and the other ends of the cranks fitted into the mapboard frame. The mapboard is oriented roughly by shifting the table frame, which is then fastened loosely by one screw. The table frame is then swung around this screw until the mapboard is accurately oriented and the remaining screws are put in and tightened.

Obviously, a third form of mounting may be developed by fastening legs to the lower frame to form a pedestal or stand, thus eliminating the table. Orientation would be accomplished by shifting the stand, fastening it securely to the floor when oriented. An all-metal stand of this type may be grounded, profitably, in regions of severe electrical storms.

Summary

A system of 3 or more, but preferably 4 metal links or double-end cranks, one end of each pivoting at the corners of a rectangle laid out on a stationary table top or pedestal and the other ends pivoting at the corners of an identical rectangle laid out on the under side of a mapboard, constitute a system of parallelograms which will maintain the orientation of a fire-lookout mapboard during movement of the mapboard to secure a clear line of sight to a fire past any upright structural member of the lookout cabin, such as corner posts. The movement of the mapboard is constrained by the links or cranks, so that any point on the mapboard will describe a circle of radius equal to the length of the links or cranks. When these are 6 inches in length the resulting displacement is 12 inches, adequate for giving clear vision past most structural obstructions. The accuracy of orientation is extremely high; with an allowance for play in the bearings of 0.02 inch the maximum error is $\pm$ 4.3 minutes of arc for a 14x24-inch spacing of the pivots or bearings.

SOIL FACTORS IN RELATION TO PROPOSED PLAINS SHELTER BELT PLANTINGS

By M. F. MORGAN

Agronomist, Connecticut Agricultural Experiment Station

THE proposed shelter belt in the short grass prairie region of the middle-western states in its extension from the north Texas panhandle to the Canadian border in the eastern half of North Dakota at a width of 100 miles would include soils of two major pedalogic groups. These are the black or grey-black soils of Chernozem character which extend eastward to the soils of the "tall grass" prairies and the dark brown (chestnut brown) soils which extend westward into the semi-arid region east of the Rocky Mountains. A common characteristic of both these soil groups is the presence of a definite zone of accumulation of calcium carbonate and related material several inches below the surface and over-lying unconsolidated glacial drift, loess and disintegrated rock material extending downward for an indefinite distance to bed rock.

The presence of this zone of carbonate accumulation is evidence that the rainfall is insufficient to cause penetration of percolating waters below this depth. Calcium in the upper portion of the soil column, either derived directly from disintegrating calcareous material or formed by weathering processes from non-calcareous minerals, is carried downward by percolating water as bicarbonates. Since the rainfall is insufficient to wet the soil below a definite depth, at the lower zone of average moisture penetration the bicarbonates are deposited as carbonates, resulting in a gradual enrichment of this layer. Below the carbonate zone the material is practically dust dry at all times and has no capillary connection with the moisture in the permanent water table which, under normal conditions in level areas, lies from one hundred to two hundred feet below the surface. In ravines and depressions there may be local conditions where the water tables lies sufficiently near the surface to permit the roots of deep-rooted plants to reach it.

There is a fairly definite relationship between the depth at which the zone of carbonate accumulation occurs and the rainfall. In the latitude of northern Kansas the appearance of a definite carbonate horizon occurs at a mean annual rainfall of about 25 inches and lies from four to six feet below the surface. Traveling westward one encounters the carbonate zone at decreasing depths to from 15 to 24 inches below the surface in eastern Colorado. Roughly speaking, at the eastern border of the shelter belt the carbonate horizon starts at three feet and at the western border at 20 inches. The thickness of the carbonate zone normally increases from east to west up to a maximum thickness with a mean annual rainfall at about 20 inches, and becomes somewhat thinner in proceeding further toward drier climatic conditions. The variation in thickness within the shelter belt area should range from 8 to 15 inches.

The soils of the eastern part of the shelter belt are high in organic matter, as might be suspected from their color. With increasing aridity the accumulation of organic matter in the soil decreases, probably as a result of the decreased density of the virgin grass cover. The organic content also decreases toward the southern portion of the shelter belt. However, the organic content of the soil with-

in the shelter belt is favorable for plant growth if adequate moisture conditions are provided, with the exception of some of the excessively sand soils of the "sand hill" region of Nebraska. As a rule, the heavier textured soils contain larger amounts of organic matter. The presence of an abundance of soil humus under virgin conditions has resulted in a naturally favorable physical condition for tillage operations which has tended to disappear after long periods of farming.

In the eastern part of the shelter belt where the rainfall should be most favorable for tree planting the sub-soil conditions in a horizon just above the carbonate zone are somewhat undesirable on account of the accumulation of clay at this level, sufficient to seriously interfere with root penetration. The so-called "clay pan" gradually disappears in proceeding westward into the chestnut colored soils.

As a result of variation with respect to character of parent material and topography, many different soil types are encountered in the shelter belt, and changes due to the differences in climate in its long extension north and south also act to favor soil diversity. Many areas do not show the definite characteristics which have been pointed out in describing the major soil groups. Textural variations are rather wide, ranging from heavy clay loams through the silt loam, fine sandy loam, sandy loam, and sand classes. The silt loam and fine sandy loam textures are predominant over the major portion of the shelter belt.

Relationships between soil texture and favorable moisture conditions for tree planting present an interesting contrast to those which are generally accepted in humid regions. If receiving equal amounts of rainfall, sandy soils in the shelter belt area are probably more favorable for tree growth, since a larger percentage of the rainfall is absorbed by the soil against run-off. None of the water is lost by downward leaching, and the sandier soils provide better surface mulch conditions against evaporation losses. A heavier soil has less ability to liberate moisture to the tree roots, since its wilting coefficient is higher. The presence of a "clay pan" in some of the heavier soils also tends to decrease the amount of free moisture in the soil. It has been frequently pointed out by enthusiastic supporters of the shelter belt that plantings in the "sand hill" region have been generally successful. Under humid conditions the "sand hill" soils would not be desirable for tree planting in competition with the heavier soils, but the reverse is likely to be the case under conditions such as prevail in the shelter belt.

As a result of soil and topographic variation within the shelter belt there are undoubtedly many areas which present soil moisture conditions sufficiently favorable for the growth of a tree species which is adapted to withstand long periods of soil dessication. The selection of favorable sites for tree planting in the shelter belt would require close coöperation between the forester and the soil survey specialist if any measure of success is to be obtained. Apparently both soil and forestry experts are in agreement in opposing any plan for indiscriminate tree planting in arbitrary lines at fixed intervals without regard to soil and topographic factors. However, this feature of the project, at first so widely heralded by the press, is apparently not to be developed under present plans.

A METHOD OF TRAVERSING ROADS

By C. R. Clar

Forest Technician, California State Division of Forestry

Under the necessity of preparing usable working maps for forest protective units not covered by U. S. Geological Survey maps, the California State Division of Forestry has been making its own maps using available road network as the master control. The search for a rapid and reasonably accurate method of traversing roads led to adoption of the technique described, by which as much as 20 miles of unfamiliar winding road may be traversed in one day.

THE California State Division of Forestry is mainly concerned with forest protection from fire on some thirty million acres of private land outside the national forests. Approximately one-half of this area is classified as timber or valuable watershed area and generally forms a buffer strip between the forest and agricultural land below. Because of the lack of intensive land use in this timber-watershed area there has been a natural tendency on the part of the U. S. Geological Survey to concentrate on mapping other parts of the state as funds are provided.

For years a need for even the most meager type of administrative maps has been felt by the Division of Forestry. The county is the administrative protective unit, but there are very few satisfactory county maps available. Such county maps as do exist are poorly projected and are usually abstracted from obsolete office data. A constant triangulation from fire lookouts quickly accentuates the failing in true protection and emphasizes the need for good maps. Where topographic quadrangles of reasonable youth are available the matter is, of course, simplified to a pure drafting job, with the addition of administrative details.

Emergency conservation work, in addition to the program of preparing a comprehensive fire plan, has made it imperative that a usable working map for each protective unit be constructed.

The huge task was considered from several angles. To compile accurate drainage maps, or to correct the questionable land subdivision survey, would be out of all reason when one considers the large area involved and the resources at hand. The solution seems to be in using a road network as the master control for our maps, both because roads are of vital importance in our business and because they are so available to work.

A rapid, yet reasonably accurate, method of traversing roads was searched for. Finally a contrivance was assembled under our direction at the state highway shop in Sacramento. The azimuth circle of a new Osborne firefinder was fitted to a specially made iron plate of quarter-inch material. The two were fastened together with a bolt through the center hole of the firefinder. A common one and one-half inch water-pipe flange was fastened beneath the iron plate with two bolts. To the flange a Barco joint was attached, making an excellent ball and socket joint capable of a 30° deflection from vertical. An eight-inch horizontal handle was bolted to the joint to adjust friction tension. Below the joint a length of one and one-half inch pipe, another flange, and an almost horizontal iron tripod were affixed. The instrument stands four feet high from the floor to the alidade sights, and weighs approximately thirty pounds. Labor and parts, exclusive of the firefinder circle and cyclometer, amounted to about $15.

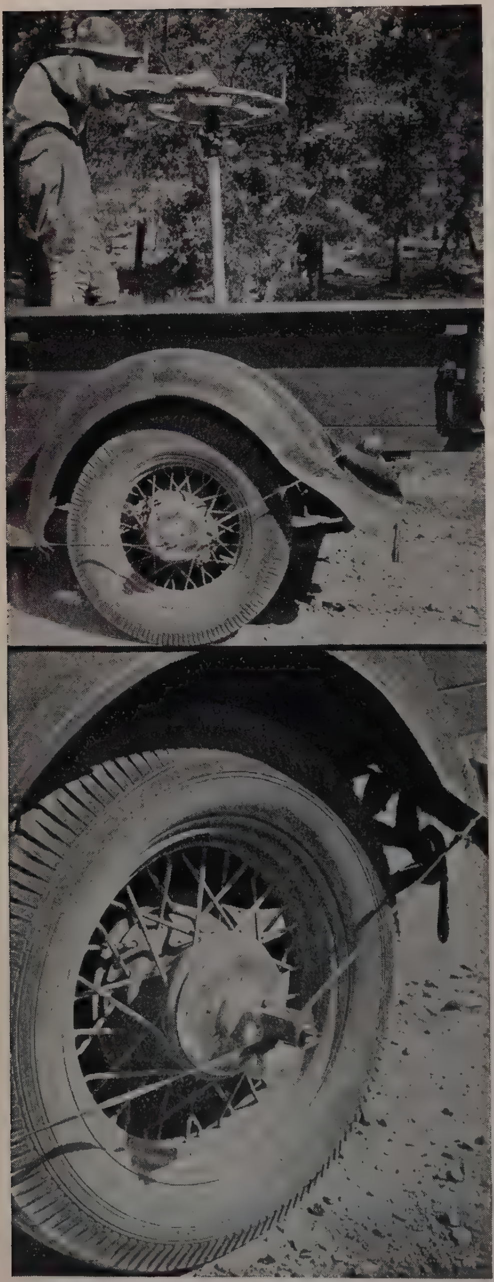

Fig. 1.—The road traversing equipment in operation. Top: The instrument "zeroed" on a backsight. Bottom: The cyclometer.

It can be unassembled easily at any of the bolt connections and reassembled for use in any pick-up truck with two or three sand bags weighing down the flat tripod legs. We now have an instrument for reading foresights and backsights to one minute of angular accuracy. The process of setting the alidade at zero reading, striking an approximate level according to two spirit levels placed at right angles, sighting on the backsight, and tightening the ball and socket head requires only a fraction of a minute. The problem of suitable fore and backsights is, of course, another matter.

Since the azimuth circle is the key to the efficiency of our instrument its construction must be thoroughly understood. The principle of a firefinder is, of course, to allow an observer to report the angular bearing of a fire between his position and true north, since north is always considered zero azimuth in our work. Osborne has developed a horizontal circle of light alloy, about twenty inches in diameter, plainly marked at degree and half degree intervals. This circle is bolted fast to a heavy plate which is allowed to slide in one direction just enough to clear window frame obstructions in the lookout house.

We have detached the heavy plate and use only the scribed circle with its tight-fitting sliding ring whereon a set of upright alidade sights are fixed. Also, on this sliding ring is a small handle for turning the ring, and directly behind the rear sight is a vernier which makes a reading to one minute of horizontal angle quite simple. The rear alidade sight is so scribed and fitted with a movable peep sight that vertical angle may be read across a front sight cross-hair.

It is important to understand that we have here a rought transit in effect at a very nominal cost.

For a distance recorder we were fortunate enough to find at the highway shop a left wheel hub cyclometer, recording to

one-tenth of a wheel revolution. A special disc was made for bolting to any hub cap. Fortunately, the numbers on the cyclometer are large enough to be easily read by a man standing in the truck bed. It should be remembered that the circumference of a wheel is quite variable. Our constant is obtained by rolling the wheel through ten revolutions over level road and measuring the distance with a tape. However, the office plotting of courses, even at our adopted scale of ten inches to the mile, allows so much drafting error that we are not greatly concerned with obtaining ridiculous accuracy in distance. Fractions of feet are credited against the accumulation of weaving turns. Allowance is made for slope only where that slope exceeds two degrees of vertical angle.

The matter of sights is governed by the accuracy that we desire and the help available. Two extra cars to serve as fore and backsights are ideal. One extra car is almost as valuable when used in the following manner. A prominent radiator cap or attached white flag is the object of sight. When the instrument man sets his instrument he notifies the driver (note recorder) who signals the rear car to come forward. Upon its arrival the instrument man is ready to point out the object of his forward sight. The instrument car proceeds and the rear car moves over its vacated position. When the instrument has reached its destination and is *on line* the rear car gives a horn signal.

In this manner an excellent traverse over 20 miles of unfamiliar winding road may be completed in a day. At this writing we have just closed 12 miles of road traverse with an error of 200 feet. Field work took four hours in the manner just described, and office compilation took a full day.

If necessary we can use low targets manufactured with wire, looped into a circular base and extended up eight or ten inches to clamp a white flag. These may be set on turning points before the traverse begins, or on backsights, as the instrument moves ahead.

Since there is so little check against error it is of utmost importance that the field party take special care in reading and recording angles and distances. Auto speedometer readings should be recorded frequently as well as side shots to known points.

The technique of any particular survey will, of course, vary with our requirements and the conditions at hand. The final accuracy of our work may be said to vary directly with the triangulation network established by the Geological Survey, and with whatever similar control we take time to establish ourselves. We may repeat the traverse of a well situated road until its certain accuracy offers us a master control for secondary surveys. Whenever a transit is available occasional solar observations are taken for course bearing; otherwise a compass reading must suffice.

We are confident that we have a system of traversing that can be very nearly as accurate as transit and stadia work when such accuracy is desired, at the same time being fully five times as fast, and very much less expensive in equipment, assuming that a truck is provided in both cases. Then too, we have solved that perplexing question: what to do with the firefinder in winter time.

NOTES ON WOOD SECTION MICROTECHNIQUE

By HEREFORD GARLAND

Technical Assistant in Forestry, University of California[1]

The author supplements earlier articles on microtechnique with many helpful suggestions for the preparation of wood slides for study under the compound microscope.

ONE of the requisites of a good technique in wood section preparation for microscopic study is an accumulation of effective details of operation. The existing literature (a partial list of references is given at the end) furnishes an adequate foundation for this store of knowledge, but in practice technicians are frequently rejecting or augmenting these detailed instructions as individual conditions vary and experience is developed. Wood technologists have not availed themselves sufficiently of the opportunity of exchanging ideas on microtechnique through building up a more detailed literature.

The writer offers these notes as the fruit of experience gained in making some 4000 slides of commercial woods for class use and research in the wood technology laboratory of the Division of Forestry, University of California.

Choosing the Specimen

(1) Carefully study the wood from which the microtome block is to be taken. Do not risk wasting the effort of making a good micro-slide of wood that is not perfectly typical of the species, type or characteristic that the sections are meant to illustrate. It is well to refer to technical texts and keys to check even seemingly correctly identified specimens.

(2) The block should contain at least one annual ring with parts of the adjoining rings, and the natural curve of the ring should be shown.

(3) The blocks should be of a size that will yield sections as large as will fit under a cover glass in sets of X (transverse) section, R (radial) section, and T (tangential) section. Beginners should anticipate a large number of unsatisfactory sections and should make the block correspondingly over-sized in the longitudinal and tangential dimensions (assuming the sections are to be cut in the order: X, R, T).

Preparing the Blocks

(1) Cut smooth or sand the end of the block from which the X section is to be taken.

(2) Mark the other end with grooves or notches and record the mark with species, source and other data immediately, so the block can be readily identified, if mixed with other blocks or misplaced. Numbers stamped on the end are not permanent. The die merely distorts the wood elements and soaking springs them back to their original positions.

(3) Boil the blocks for an hour; add cold water and if they still float, boil again.

(4) The softer hardwoods and most of the softwoods do not need further softening. Unless the wood is obviously too hard to section, try it on the microtome. The best sections come from blocks that are just a little softer than too hard. Do not soften the wood merely to avoid polishing the edge of the knife frequently.

[1]The writer has since become Junior Forester, U. S. Forest Service.

The hardness of a wood for cutting on a microtome cannot be estimated by whittling a stick with a pocket knife. Blocks that cut on the X section with a sharp hand razor like hard rubber should be ready to section with the microtome.

Blocks that need softening should be soaked in 30 per cent or 60 per cent hydrofluoric acid. Those that are almost soft enough should be put in 30 per cent acid and should be tried with a razor every three or four days. If the 30 per cent acid does not seem to give a softening effect, move the block into the stronger acid. Very hard blocks should go directly into the 60 per cent acid and should be examined after two days and twice a week thereafter. Wash the blocks in running water not less than forty-eight hours before cutting on the microtome.

(5) Forty per cent alcohol is a satisfactory storing medium for the blocks. The glycerine-alcohol mixture recommended by some may oversoften the wood.

Preparing the Knife

A machine for sharpening and polishing the knife is strongly recommended for sliding microtome work because it can produce a uniform edge along the full length of the knife and it simplifies keeping it in perfect cutting condition.

The machine that the writer has been using is one designed by Prof. J. A. Long, Dept. of Zoology, University of California. It consists of a disc of one-half inch plate glass mounted on the shaft of an electric motor, and a guide upon which the knife is moved across the periphery of the revolving disc. The motor is mounted on a movable base so that a screw motion can move the glass wheel toward or away from the guide, and a vernier affords adjustment to a tenth of a millimeter. The setting for a given angle of bevel can be computed.

(1) To prepare a knife the machine is set for a sharpening bevel and some tap water is placed in the reservoir which forms the bottom half of the disc housing, and levigated alumina is added. The knife is passed back and forth in the guide across the glass wheel until the grinding compound has produced a uniform "rough" edge as shown under a compound microscope.

(2) The machine is then cleaned of all the abrasive and is reset for a polishing bevel, i. e., the wheel is moved away from the guide to provide a more obtuse angle of bevel. For the polishing operation a continuous fine stream of distilled water is allowed to flow on the wheel. With practice attended by frequent inspection of the edge under the microscope the technique can be developed to a point where it becomes a simple matter to rehabilitate a knife after it has begun to produce poor wood sections. It has been found that this can usually be accomplished by six or eight polishing strokes.

Sectioning

(1) If a machine is used to polish the knife, the angle of the polishing bevel can be computed and the vertical adjustment of the knife in the microtome should be such that the bottom side of the bevel is parallel with the top of the block. If a hone and strop are used to prepare the knife, this angle must be found by trial and error. A balance must be struck between excessive curling of the section and dragging the "heel" of the bevel over the block.

(2) Keep the knife at as acute an angle with the line of motion as practicable. Just a few degrees may mean the difference between a scratch on the section and no scratch.

(3) With a camel-hair brush, keep the top of the block and the top of the knife

edge flooded with 40 per cent alcohol.

(4) Hold the section flat on the knife with the brush while cutting.

(5) Ordinarily, X sections and R sections can be removed from the knife by letting them cling to the wet brush. T sections are usually very flexible and should be floated off the knife on to a flooded spatula.

(6) The work should be done under a portable lamp and it should be placed so that it will reflect off the top of the block in the microtome. Many scratches and other imperfections in cutting may be detected in this manner without too frequent recourse to the microscope. Glass-like smoothness of the top of the block indicates a perfect knife.

(7) If the work is interrupted for a few minutes the top of the block may be kept wet by covering it with a small saturated piece of blotter.

(8) Sometimes with a dense wood, a freshly polished knife will give alternate sections that are thick and thin at the end of the stroke. Continued cutting dulls the knife slightly so that the sections come uniform.

(9) X sections should be cut with the annual rings parallel to the motion of the knife. R and T sections should be cut with vertical elements parallel to the motion. T sections should be cut a little off the plane of the annual ring and through the border of an annual ring so that there will be both springwood and summerwood on the section.

(10) Signs of a dull knife: Portions of the springwood or parenchyma cell walls torn and pulled into the lumen on the T section. Holes on the section at the rays in the R section. Walls of the vertical elements distorted in R and T sections. Ray cells torn in T sections.

(11) When sections curl annoyingly in cutting, take a thick cut (60-100 micra), but retard the knife before the cut is quite complete, leaving the section attached to the block just at one corner. Then cut a section of the desired thickness (or several sections, leaving each attached at the corner) under this stiff top section. The thick section does not curl excessively and prevents the attached sections from doing so. The sections can be run through the stain and the alcohols to xylol attached to the thick section; by then they will be stiffer and can be torn free and flattened on the slide.

(12) Very thin sections (5 micra) can be gotten by coating the top of the block with 2 per cent celloidon. Put a few drops of absolute alcohol on top of the block, then a few drops of alcohol-ether, and then two applications of 2 per cent celloidon. Cut in absolute alcohol. The celloidon can be washed from the section while it is on a slide by gently dropping alcohol-ether on it.

Staining and Mounting

(1) Ordinarily staining is not recommended for woods with pronounced natural color. Safranin (1 per cent aqueous solution of Safranin Y) is a satisfactory stain for xylem. From 40 per cent alcohol move sections to safranin for a few to 10 minutes, then to 40 per cent, to 95 per cent, to absolute alcohol, and another absolute alcohol for a few minutes each. If many sections are being handled from the same dish, it is well to change the absolute alcohol frequently as the work progresses because it takes up moisture from the air.

(2) Move each set of sections into xylol as they are to be mounted.

(3) X sections that are difficult to uncurl and flatten on the slide can sometimes be flattened on a spatula in the xylol and then slid onto the slide flat. Fragile T sections usually curl badly when put in xylol. To prevent this they may be flattened on a spatula in the abso-

lute alcohol and drained by touching the edge of the spatula on a blotter and then put in the xylol for a few seconds still on the spatula and then slipped on the slide.

(4) When all the sections are in place on the slide (R and T sections side by side and X section above them) the excess xylol may be removed by barely touching the edge of the sections with a piece of blotter.

(5) Drop the minimum amount of balsam on one side of the set of sections. Heat the cover glass preferably over an electric plate or dip it in absolute alcohol and burn it off. Use forceps that are very thin and are bent to an angle of about 20 degrees at the tips of the prongs. Grip the cover on one side and touch the other side on the balsam and hold it to the slide. Then lower the held side slowly over the sections so the balsam will flow between the slide and cover without enclosing air bubbles. Put the slide aside for a few moments and then press it down gently with a needle. Bubbles can be worked to the side and some shifting can be done in this manner. Put a 25 gram weight on each cover and put the slides in a warming oven (about 50° C.) over night or longer. A secondary dryer of larger capacity can be made by putting an electric lamp in a box with ventilated slide trays.

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A SIX-YEAR FORESTRY PLAN FOR MEXICO [1]

By ENGINEER MIGUEL A. DE QUEVEDO [2]

President, Forestry Society of Mexico

This Six-Year Plan for Forestry appeared in the November-December, 1933, issue of "Mexican Forestry." Prepared by Dr. de Quevedo, assisted by a forestry society committee at the request of General Lazaro Cardenas, presidential candidate, and several senators and congressmen, the plan has been approved by the Forestry Society of Mexico. It is a part of a broad six-year national political and economic plan proposed by high Mexican officials for the coming national administration.

The foreword and explanation of purposes of the Plan covering four pages, as well as a five-page budget, because of space limitations are omitted from these extracts. Wide liberties have been taken with the text in order to render the scope of the Plan more readily understandable to American readers and to save space; this is by no means a literal translation.

This digest of a proposed forestry organization for Mexico should be of interest to American foresters, interesting because of its similarity as well as its dissimilarity to our own; it is patterned largely from European models. In any case, the Plan in many respects is quite progressive; it also shows the great need of forestry in Mexico.

Dr. de Quevedo, distinguished engineer and patriotic citizen of Mexico, "The Father of Mexican Forestry," has long been interested in and a strong supporter of a national forest policy for his country. He is thoroughly familiar with the forestry methods, policies, and practices of Europe and America. He was the leading Mexican delegate to the famous American Forestry Congress of 1909, and is now President of the technical forestry society of Mexico and an Honorary Member of the Society of American Foresters.

I was informed that not only was this Six-Year Plan approved in principle by the presidential candidate and by the National Convention held in April, 1934, but that the Department of Forestry has already been organized and more recently that favorable action on the law making this Plan effective is assured.—JOHN D. GUTHRIE.

WE SEE in the neighboring United States a powerful reaction with President Roosevelt making reforestation the first chapter in his government's program, and providing funds in large quantities for that great work. Mussolini is acting accordingly in Italy, and the old nations, the wisest of Europe (Sweden, Switzerland, France, Germany, etc.), base their fundamental economic, social and biologic balance on the protection of their forests. Even Russia in her Five-Year Plan Program establishes wise exploitation of her forests. If Mexico finds inspiration in this world-wide movement and reacts accordingly, having as a motto "Necessary Protection of the Country's Forests," she can well aspire, in view of the potentiality of her marvelous flora, to base her economic balance to a large extent on her timber resources, and become the Switzerland of America.

Basis for the Organization of the Forestry Service

It is of the greatest importance for the economic future of the Nation, as well as the well-being and health of the public, to conserve the remaining forests of the land and to begin the reforestation or restoration of forests in barren mountainous non-agricultural regions. Here it is also advisable to develop and protect the grazing and cattle industries, to give greater value and derive more profit from the vast woodlands that constitute three-fourths of the area of the Nation.

In Mexico to obtain the necessary action in proper forest management, the

[1] This sets forth the broad economic and social reasons and backgrounds of a proper forestry policy for the nation, the world's historic examples of forest care and abuse being cited. The abridged extract from this part of the Plan is given as showing Mexico's efforts to keep abreast of world movements in conservation.—J. D. G.

[2] Dr. de Quevedo has recently been nominated by President Cardenas as Director of the new Department of Forests, Game and Fish.—J. D. G.

restoration of lost forests, and the development of grazing lands, the organization of an efficient forestry service or forestry administration is necessary. The latter cannot be successful if it is made dependent on an official entity such as the Ministry of Agriculture really is, since the Ministry, on account of its natural agricultural leanings, tends to disregard the Forestry Service, considering it of secondary character.

The agrarian policy prevailing in the Government and in the rural population since the Revolution is influential in the indefinite granting of lands to towns and their later subdivision for agricultural purposes. In general no consideration has been given to the question of proper boundaries or study of lands adaptable to subdivision as suitable for agriculture or for grazing and forests. Such use should be under a perpetual conservation plan since the contrary policy of subdivision and town grants only leads to ruin of the land, especially so in protection forests on steep slopes. Similarly on lands of high altitude and of low mineral value, agriculture only impoverishes the land. Consequently, mountain settlements are reduced to ruin with the accompanying disastrous effects on climate and stream flow.

Agrarian abuse has been leading extensive regions to total ruin, as with Greece and Rome. Such policy must by all means be avoided. In many cases the ignorance of laborers as well as the insistency of outside speculators in converting timberland into steep and unprofitable agricultural land are a detriment to a high agricultural ideal, causing ruin of towns instead of contributing to their prosperity.

The wealth of the mountain is in its timber and grazing lands, and the barbarous practice of raising corn and beans on such lands is a practice both economically and biologically absurd and should be stopped.

It is impossible for the Department of Agriculture to remedy its present agrarian policy; the Forestry Administration cannot, due to its secondary place in this program and because of its dependency on the Department.

Against the exploitation of natural resources of the Agrarian Law we must set up the Forestry Law which will control this wealth and save the country from the disastrous ruin toward which it is headed.

If three-quarters of Mexico are true forest lands and less than one-quarter agricultural lands, it is absurd to permit agriculture to predominate over forest protection. The importance of forestry justifies the establishment of an Executive Forestry Department, though supporters of forest protection do not aspire to such an ideal. If it were necessary, in order to guarantee the public health, to establish an independent Health Department directly under the Executive, is it not more reasonable to establish an independent Forestry Service, also directly under the Executive? The Forestry Service should have its own budget, ample enough to handle efficiently this valuable source of public wealth, the conservation of which has a direct influence on public health and on the general well-being. Only by this means can the forests and other natural wealth be saved together with the general wealth of the nation itself. The interest of the public welfare, the Government, and the informed classes will undoubtedly respond in carrying out this much-needed measure.

An Independent Department of Forestry

I. Division of Forest Conservation—Forest Management

The organization should be based on efficient and sustained attention to the

two primary needs, the conservation of existing forests by proper management, and the reforestation of bare lands. Based on the above are the two main divisions of the Department, namely, Forest Conservation and Reforestation. The first division includes three sections covering the three classes of forest lands—national properties, communal or municipal property, and private forest ownership. This subdivision is necessary on account of the different technical and administrative methods required and the different economic aspects involved. Forest administration on the ground will demand the organization of a highly specialized personnel for inspection and warden service to handle conservation and management; a similar division is needed in the central office of the Department of Forestry where these questions should be handled separately.

The objective of these three sections of Forestry Division I is to bring in the shortest time possible these different forest properties to full and producing capacity, having in mind sustained conservation and improvement of this forest wealth, in accordance with the economic principles of permanent and increasing financial returns from the Forest Capital.

Section 1—National Forest Reserves.—This Section will have to develop first the program of examination and accurately marking the boundaries of the area of the national lands forming the Reserve. It must assume control of these lands, establishing a force of forest guards and a system of technical inspection. In addition to protection, the work of land classification and road construction must be carried on to insure forest utilization. Properly located military guards would help in forest protection and also in mountain road construction.

There are 81,543,000 acres of national lands, more than fifty per cent covered by rich forests; these must be conserved by being placed under a sustained yield system for the benefit of the National Treasury. This requires a different system than the present one, which grants concessions to individuals who ruin forest resources and pay to the Treasury only an insignificant sum in return.

Forest exploitations would be handled by the Department of Forestry and should have the help of an administrative commission composed of representatives of the Treasury Department and the Forest Association. Through forest utilization the Treasury will obtain a continuing and considerable income, the importance of which cannot be overestimated, being derived almost entirely from valuable tropical woods.

At present forest concessions in tropical woods bring the Treasury a little over 400,000 pesos anually; these concessions would be maintained pending organization of the new regime of reserves. After a few years this system should put such lands on a productive basis, with an income much in excess of returns from the taxation of mines, petroleum or exploitation of the reserves already contemplated by the Government.

Of the 81,543,000 acres of federal lands the national forest reserve should include not less than 61,775,000 acres, including those of the Southeast Territorial Zone. The reserve should be greatly increased, as for example by adding those of the Northwest Zone and all that can be allotted of the Central Zone through land exchanges. The main object is to have reserves in those mountains constituting the upper basins of the principal rivers, themselves of greatest benefit to agriculture and industry, to keep these basins in forests for water resources maintenance. This is possible only under national ownership.

Besides the national advantages of forest reserves from an economic view (the income might exceed 200,000,000 pesos

a year) and the climatic and waterflow advantages, we shall fulfill the moral promise made to the International Conference for the Conservation of Natural Resources of North America, held at Washington, D. C., in February 1909, attended by delegates from the four nations of the North American continent, including the Mexican Government. At this conference it was agreed that the fundamental measure of a program of conservation involved the forming by each government of an extensive national forest reservation system such as already established by Canada, the United States and Newfoundland. At this Conference the writer, representing Mexico and empowered as one of its three delegates, promised that Mexico's forest reserves would be not less than 49,420,000 acres. To this end, in December, 1909, the new Agrarian Law was formulated which prohibits the issuing of grants for national lands. This promise made at Washington must be fulfilled by setting aside such forest reserves.

Section 2—Communal and Municipal Forests.—There must be developed a program of protection against overcutting and splitting up of forest lands for agricultural purposes in broken country or in soils unfit for cultivation, or in protection zones in mountainous regions. Efforts should be concentrated upon well-directed forest culture and permitted grazing of cattle, both producing large permanent incomes. The proceeds from communal and municipal forests should be distributed as follows: 60 per cent for public service and improvements in the local community, 20 per cent to the Federal Government for expenses connected with technical personnel and wardens, and the remaining 20 per cent for forest improvements and the restoration of denuded areas. Communal forests must develop this program in conjunction with the grazing section since in the mountains the forest and rich meadow lands should be protected to insure the welfare of inhabitants other than those dependent on mountainous fields of corn and beans.

Here is the most fruitful and productive forestry objective under Mexican constitutional decree. It lays down the rule that only agricultural land not located in the mountains may be parceled out, and that communal or municipal forest and grazing lands may be used in common; this can only be attained under the regulatory, technical, and administrative direction of a forestry department. Let agricultural commissions and allied organizations handle the agricultural plains regions proper, but place the non-agricultural hills and mountains under the control of the Forestry Department. Moreover, this plan would not be an obstacle but rather an advantage in that the cattle section of the Department of Agriculture could coöperate with the Forestry Department in developing the best breeds and in advancing the dairy industries of the mountains, whose products are considered the finest. An allotment of 100,000 pesos has been made for wardens and technical inspection of communal forests, to be compensated to the National Treasury by the return of 20 per cent of receipts from their commercial management and utilization; an increase or reduction may be advisable later.

Section 3—Private Forests.—This Section has its important program of enforcing the laws of forest exploitation and utilization under forestry principles for a maximum permanent output, and an improvement in the quality of the product. A stimulation of the owner's interest in this improvement is needed to fill the needs of national consumption with better quality products and imports. Exports of our forest products should be thus based on an excellent natural quality. There remains the commercialization of this production by applying technical principles which should guarantee their

indefinite conservation and betterment.

The sum of 200,000 pesos is set up for guards and inspection of private forests reimbursable to the National Treasury from revenue from taxation of exploitation operations, which tax should not be grievous. This must be the only tax; overloading by local taxes might readily cause owners or exploiters to overcut, thus ruining the forest to meet excessive taxation.

II. DIVISION OF REFORESTATION

Section 1 — Forest Classification and Planting Boundary Surveys.—The work of this Section is very important, due to the vast area of already denuded mountains and hills unsuited for agriculture; they are eroded, constantly damaged, and poor pasture only during the rainy summer months, and are insufficient even for the local economic needs. This first division therefore is examination and classification of the zones in most need of reforestation. The process of deforestation has been carried on to such an extreme that only a forest coefficient of 12 per cent is available while a proportion of 40 to 50 per cent is required considering the very mountainous topography. The above work of examination and classification should be ably assisted by the Division of Conservation through its three Sections, since reforestation must be carried out on all three classes of lands—national, communal and private.

Section 2—Reforestation and Nurseries.—Reforestation will be handled by this Section whether at the expense of the states, the federal government, or municipalities, or private owners. It will advise as to suitable trees and the best planting methods; also direct the establishment of permanent or central nurseries, this work being properly a function of the Department of Forestry. The distribution of seedlings should be made as widely as possible. A sum of 200,000 pesos is allotted equally to nurseries and to reforestation.

III. DIVISION OF RANGE MANAGEMENT AND FIRE PROTECTION

Section 1—Range Management.—Management of natural pasture lands is a very important branch of forest culture. These level lands or gentle slopes of hills and mountains constitute a great resource for the cattle industry; the forest, conserver of streamflow, may itself alternate as a grazing ground. These pastures or meadow lands now receive little attention other than the burning of the grass in the dry seasons,—a barbarous custom that impoverishes the forage cover as well as the soil itself. There is no restriction on the number of cattle using these pastures, which use is excessive to the point of exhaustion. The Department of Forestry must concern itself with this problem, thorough examinations and studies; the owners of these grazing lands must at the same time be given instruction in their proper use. Special guards (coöperating with Division 1 of Forest Conservation) will be needed to see that these natural mountain resources are properly used. For this Section of Range Management a very moderate sum of 50,000 pesos has been allotted to cover salaries and expenses.

Section 2—Fire Protection.—The personnel of this Section will carry on the fight against the barbarous practice of yearly burning of pasture lands which being the principal cause of forest fires, must by all means be stopped. Also, in harmony with the forest conservation guards and local authorities, an efficient fire-prevention service must be organized. For its outside personnel of inspection and guards the sum of 50,000 pesos has been allotted in the budget.

IV. DIVISION OF FOREST ENTOMOLOGY AND PHYTOPATHOLOGY

Forest insects and fungous diseases now destroy with astonishing rapidity both public and private forests with consequent loss of national wealth valued in millions of pesos. To remedy this evil the Forestry Department should have a division devoted to this task, composed of two sections: 1—Forest Entomology, and 2—Forest Pathology. These Sections will require an office personnel and an outside field force. The moderate sum of 5,000 pesos is allotted for each Section for salaries, expenses and equipment; this sum must later be increased.

V. DIVISION OF FOREST ECONOMY AND SCIENTIFIC INFORMATION

To popularize the work and activities of the Department and to give account of its results to the public and official authorities, the Forestry Department must have an office to disseminate knowledge of forestry by means of publications, both popular and scientific. This office shall also study the economic progress of the forest wealth of the country through a Section of National Forest Statistics, in connection and coöperation with the office of General Statistics of the Department of National Economy. The Divisions of Conservation, Reforestation, and Range Management, as well as the Institute of Forest Investigations, will also aid in such statistical work. These combined activities, studies, and investigations should eventually result in a complete and exact knowledge of the forest resources of the country, as well as their location and manner of development.

Another Section, that of Economic Studies and Scientific Forest Information, will have charge of the necessary publications, in collaboration with the other Divisions. The sum of 10,000 pesos has been allotted for the costs of publications and for expenses required in carrying on economic studies.

VI. DIVISION OF FOREST INSTRUCTION AND INVESTIGATIONS

A trained personnel is essential if the Forestry Department is to fulfill its function of vigilance over grazing lands and forest resources, to enforce the provisions of the law relating to their conservation, improvement, reforestation, and management according to the principles of sustained yield, as well as efficient forest protection. Forestry training is acquired only in special institutions devoted to this science. A number of forest engineers are required for the technical functions in the Department's central office; also a number in the forest divisions of federal forest offices of the states and territories, on whom will depend technical forestry and range inspections. There will be needed also a corps of auxiliary forest engineers for the guards or warden service, who must have a proper knowledge of forest culture and federal forest administration. These attainments are not now obtainable in this country. Because of this the present small personnel performs its duty poorly. Moreover, this personnel, lacking in the necessary discipline so indispensable to engineers and guards, cannot at present discharge their duties of forest police in the territory. An ignorant, corrupt, immoral, or undisciplined personnel which would be the kind if recruited from individuals unprepared in the special technical knowledge of forestry, as well as in the moral and disciplinary training required, would lead the Department to sure failure in all its functions.

There is no guarantee whatsover that in our School of Engineers a satisfactory professional training for forest engineers may be obtained. This has been proved

beyond question in the last few years and is true also of the School of Agriculture at Chapingo. In both schools the career of forest engineer is considered very much inferior in comparison with the training of other branches of engineering for which these schools are designed. Neither has the faculty of either school the necessary knowledge or qualifications for imparting the specialized teaching which the official and social functions of the forest engineer require. From this is seen the impossibility of bringing together in either school a sufficient number of forest engineers who may acquire the adequate training and discipline indispensable to the forest engineer corps. The Forest Department alone would have ability and qualifications to direct this teaching in a satisfactory manner. This task will be the more feasible since the Department has the advantage of having under its control all the forests and the different forest enterprises which constitute the proper field to train forest engineers, guards, and special assistants of the various branches of the service. To accomplish this, there is included in the plan of organization an Institute of Forest Engineering with headquarters in the Capitol or, to give greater facility to such training, probably in the town of Coyoacan where the large forest nursery is established and where useful experiment stations and other places for study are conveniently located.

Moreover, under the direction of the Forestry Department are planned three forest-guard schools, which should be established in a suitable location in each one of the three typical forest zones of the country, viz., the tropical, semi-tropical, and highland.

The plan of organization also considers the establishment of an Institute of Forest Investigations under the direction of the Forestry Department. The Presidential Decree for the establishment of the former was promulgated some time ago. It was designed to function in connection with the International Institute and Congress of this branch of science; but in spite of the resolution, the University has not succeeded in forming it. This task could be easily and adequately carried out by the Forestry Department since the same personnel of instruction of the Institute of Forest Engineering, together with the higher technical one of the Department, will be the most capable and competent to form a directing and collaborating nucleus of the proposed Institute of Forestry Investigations. For this purpose the sum allotted in the budget is moderate indeed.

For the establishment of the Institute of Forestry Engineering it will be necessary to employ a few foreign forest engineers, expert specialists in southern forest management and forest technology, in order to collaborate during the Six-Year Plan (or at least during three years) in the teaching of these branches as well as in the organization of the conservation service and also in that of reforestation and range management. Considering the urgent need of these experienced expert teachers, and remembering the excellent coöperation obtained from those who came to the country at the beginning of the original establishment of the Forestry Department and of the School of Forestry, the above measure is considered more necessary. Unfortunately, those engineers who came at that time from the *Service des Eaux et Forêts* of France were suddenly recalled because of our Constitutionalist Revolution and the Great European War.

It will also be advisable to send a small group of Mexican forestry engineers to the Institute of Forestry Investigations of France and to the Nancy School of Forestry, both of which institutions have already extended us invitations. From these our engineers will pass to the forestry

educational centres of Germany, Switzerland, and Scandinavian Countries.

The sum of 244,496.28 pesos allotted for the Division of Forestry Instruction and Investigations, is indeed very moderate, considering the importance of these branches. It is well to mention here that in order to obtain the recruiting of a competent personnel for a forestry service that all nations advanced in forest culture have establishments, devoted to this branch of learning, which are generously endowed. Mexico has three-fourths of her area well suited to forest growth, and having less than 100 forest engineers, needs a rapid stimulation toward forest restoration and proper forest management; this can be attained only by having a corps of forestry engineers of at least one thousand quickly and properly trained; also she should have two thousand forest guards. This should be accomplished at the rate of two hundred engineers and four hundred guards a year. To bring this about the establishments of special instruction as recommended are indispensable, and such training should be organized by the Department along quasi-military lines, with the object of attaining a thorough discipline in the Forestry Service, as is done in nations well organized in forestry.

That semi-military training of forest engineers and guards will be better adapted to the coöperation that the Regular Army must lend to the forest guard service and in their turn, the latter may act as advanced guides to assist the army in its field maneuvers, since the forestry personnel will have a detailed knowledge of the mountainous and forest lands.

The University and the School of Agriculture may also collaborate in the teaching and training of capable forest engineers particularly for use in protection and management of private lands; these may well be specialists in different branches of forestry.

VII. DIVISION OF LAW AND LEGAL ADVICE

The Forestry Department will have the responsibility of studying and presenting to both Houses the necessary changes in the Forestry Law and its Regulations; likewise it must frequently draw up legal papers regarding its forestry police service. As all applications of the law and its regulations are subject to continuous conflict with the authorities and the public, it is indispensable that there should be a Department of Law and of Legal Advice. This Law Division must have two sections: (1) Legal studies, and (2) consultation. The sum of 42,700 pesos is allotted annually for the Department's Legal Service.

VIII. DIVISION OF ADMINISTRATION AND ACCOUNTS

Finally an Administrative Branch is necessary as is customary in all public offices for records of personnel, work undertaken, of expenditures and their justification, and an accounting of all funds handled. This is especially necessary in the Department, because of its widely-scattered personnel and large expenditures and large collections. This office must be in charge of a thoroughly competent employee with the high rank of senior officer; he will represent the Chief of the Department when the latter is absent. Administration and Accounts will be allotted 234,900 pesos annually.

This item also includes expenses for general administration such as office supplies for all Divisions of the Department, furniture and buildings, or rents where necessary.

It is well to point out here that the total recommended budget of 2,000,000 pesos must be increased by ten per cent or twenty per cent in successive years for increases in the protective organization; offsetting this the National Treasury will

receive an income (from sales of timber and forest products) far in excess of such expenditures.

Fish and Game Service

Hunting and fishing are not included in this Six-Year Forestry Plan. Hunting may continue as a part of the Department, since the forests and natural meadows are the home and habitat of wild game. The personnel of forest conservation and range management may well act as game wardens; they should receive special training for this work at the Guard Forestry School and at the Institute. A special division for this work in the Forestry Department is advised, to coöperate closely with the conservation and range management divisions. A sum of 100,000 pesos may be allotted annually for this game service, which may properly include also inland or fresh-water fishing since the waters of rivers or lakes arise or run through mountainous or forest lands and therefore properly belong under the control of the Forestry Service.

The handling of sea fishing belongs in the Department of Economy, having no conection with forestry. If this Department should assume the functions of conservation of all natural resources of the Nation, then it could well remain in the Forestry Department.

THE RELATION BETWEEN TREE SIZE AND MORTALITY CAUSED BY FIRE IN SOUTHERN APPALACHIAN HARDWOODS

By E. F. McCARTHY[1] and I. H. SIMS[2]

Appalachian Forest Experiment Station

Forest fires seldom completely destroy hardwood stands in the Southern Appalachian region. Ordinarily a fire results in high mortality in the smaller diameter classes and progressively less in the larger classes. Curves are here presented showing the relation between size and mortality for fires of 10 degrees of severity. A method of rating fire intensity is suggested. It is applicable, with a few exceptions, to the region and can be used without special training or equipment.

MUCH the larger part of the Southern Appalachian forest has been burned over. Normally, however, the fires have not killed the larger trees, and stands, even though considerably below merchantable size, have not been completely destroyed. But though large trees survive the ordinary fire, smaller ones, which form the basis of future stands, suffer mortality in proportion to their size and to the intensity of the fire. In the study here reported the senior author determined, from data collected on various species of oak and of chestnut, the relation between sizes of trees and mortality in forest fires of different intensities. The data were collected from three widely separated localities within the region.

The field work on which this paper is based was done by the senior author during 1922 and 1923. The locations of the burned areas studied and the conditions represented are given in Table 1.

In sampling the study areas the senior author measured the trees on chain-wide strips and tallied them by species and diameter (breast high) as uninjured, injured, or dead. The strips were regularly spaced and usually covered about 10 per cent of the burned area. Separate records were kept for the different conditions and fire intensities encountered on each burned-over area.

The tally records of oaks and chestnut were taken for the 11 divisions of the three burned areas, as given in Table 1, and for each division the percentage of mortality was computed for each diameter class on the basis of total number of trees in the class. Although the curves derived by plotting the mortality per cent over diameter were somewhat irregular both in shape and in spacing, a marked relation of diameter to mortality per cent was noticeable in each.

While this relation was apparent for individual curves, these curves, of course, differed considerably in slope, since they represented fires of different intensities. An index of fire severity was therefore sought by which the different severities represented by the curves could be related and measured in the field. For this index the mortality in the 3-inch diameter class was selected. The 3-inch class offered the best possibilities because some trees of this size are usually killed in the lightest of fires, and it is seldom that an intensity is attained which results in complete killing of this end of larger size classes. For the index, the mortality in the 3-inch class, from zero to 100 per cent, was divided into even 10 per cent units.

The next step in the analysis was the preparation of a curve for each diameter class by plotting mortality per cent for the class, as read from the first graphs, over severity class (per cent of 3-inch trees killed). This further smoothed out the irregularities of the data and per-

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[2]Assistant Silviculturist.

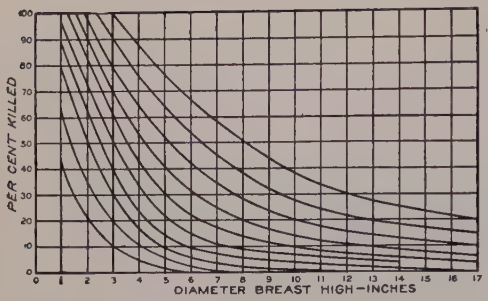

Fig. 1.—Percentage of oak and chestnut trees killed by size classes in fires of different severities. Severity measured by the percentage killed in the three-inch class.

mitted adjustment of the curves in the following step to even 10 per cent mortalities in the 3-inch class. From these curves new ones were constructed for each 10 per cent mortality class, using severity class as ordinates and diameter class as abcissae. The curves in the accompanying Figure 1, constructed by reading values from the third set of curves, show mortality by diameter classes for fires of different intensities, as measured by percentage of 3-inch trees killed. When checked against the original data, these curves show a standard error of estimate of about 6.5 per cent.

While the curves as shown in Figure 1 are based only on the data for several species of oaks and chestnut, similar curves based on mortality in all species showed close conformity to those presented. The curves, therefore, may be considered applicable to all hardwoods in all forest types of the region in which oaks and chestnut are prominent. It is not likely, however, that they will be found applicable in the northern hardwood types where beech, birch, maple and other thin barked species are abundant. These species, in addition to being more susceptible to basal injury than the oaks, frequently suffer severe root injury in forest fires.

Chestnut was included in the computations because its reaction to fire is essentially the same as that of the oaks. At the time the data were taken the chestnut blight was not severe enough on the areas studied to obscure the effects of the fires.

No special discussion is required for an understanding of the curves illustrated. Each curve shows the mortality, in other diameter classes, associated with a given mortality in the 3-inch class.

Forest fire in the hardwoods of the Southern Appalachian region is characteristically variable in intensity. The causes of this local or spotty variability are to be found in the various combinations of weather conditions, fuels, and topography existing at the time the fire burns. All of the factors are subject to great changes within short distances or periods of time.

Variation in fire intensity probably influences the shaping of the mortality curves as much as does the resistance of the trees. This, in turn, is dependent on

Table 1

BURNED AREAS FROM WHICH DATA WERE OBTAINED

Location	Date burned	Date examined	Age class or topographic conditions present
Cecil County, Maryland	April 30, 1922	Sept., 1922	20-30 yrs. old; 30-60 yrs. old; 30-100 yrs. old; 60-100 yrs. old; 16-25 yrs. old.
Rock Creek, Unaka National Forest, Tenn.	Oct., 1921	July, 1922	Lower dry slope; lower moist slope upper dry slope; uppr moist slope.
Towns County, Georgia	July, 1922	July, 1923	Upper dry slope; cove.

hickness and irregularity of the bark at he base of the bole and on height of rown. Thus, in very light fires mor- ality in the smaller diameter classes is ikely to be generally distributed, where- s mortality in the larger classes is re- tricted to areas of higher intensity. In nore intense, and therefore more uni- orm, fires the probability of chance scape is lessened and the curves ap- roach more nearly a straight line.

It is doubtful, however, if a straight ine would express the relative resistance f the different size classes even in an bsolutely uniform fire. The suscepti- ility of trees to injury is dependent argely on the thickness of the bark in elation to the intensity and duration of he fire, and also on the height of the rowns above ground. It is almost im- ossible to dissociate the relative values f these two factors. The high mortality ound in the four or five lower diameter lasses is probably a reflection of the nfluence of low crowns fully as much as f thin bark. As trees increase in size he bark becomes thicker and at the same ime the crowns are farther removed rom the fire. Either of these changes ncreases tree resistance. Increase in ef- ective bark thickness is limited, how- ver, by the formation of crevices, and ncrease in height of crown is limited by the site quality and density of stand. Little is known yet as to the independent effects of the different factors affecting mortality.

The curves in Figure 1 suggest the possibility of rating fire intensity on the mortality in the 3-inch diameter class. Such a method could be applied uniformly over the region and would aid greatly in standardizing reports on damage compiled by the various organizations interested. Throughout the Southern Appalachians there is little uniformity of methods between the various organizations reporting on forest fires and forest fire damage. Since fires vary widely in intensity it is not logical to assign a blanket damage value per acre for all fires. The first step toward more uniform and accurate estimates of damage should be, therefore, a classification of fires according to intensity.

For assigning a monetary value to fire damage, the curves must, of course, be supplemented by other data such as stand tables for the burned-over area, species present, stumpage values, and growth-rate. For the smaller size classes, the replacement period, which includes the time required for regeneration, must be known. For managed forests, these supplementary data are usually available in more or less complete form.

MOTOR TRUCK TRANSPORTATION OF LOGS IN THE NORTHEAST[1]

By HERBERT B. McKEAN

N. Y. State College of Forestry

MOTOR trucks have been used in the transportation of logs for many years. It has only been within the last seven or eight years, however, that motor trucks have become of great importance in northeastern logging. Because of power and traction limitations, as well as the constant danger of mechanical breakdown, trucks when first used were confined to short hauls, light loads, and good roads. With constant mechanical improvement, trucks have become more and more efficient until today they are a very economical means of log transportation in the Northeast.

With few exceptions, practically all the logs of the Northeast are now transported to sawmills by truck. These exceptions are (1) the larger mills, which have relatively large timber holdings as a source of logs, with railroads built before truck operation was feasible; (2) large mills which use winter sled haul and stream driving as their means of log transportation; (3) small mills which are operated spasmodically, at best, and whose operators own and use horses for other purposes, such as farming, as well as for log hauling; (4) those mills which are located close to or in the woods where logs may be skidded by horse or tractor directly to the mill.

There are two distinct types of truck owners; namely, those who also own sawmills and operate their own trucks and those who do contract hauling. The mill owners pay the contract haulers either for the total cost of the logs delivered at the mill (including stumpage, felling, bucking, etc.), or for transportation only.

More than half of the trucks employed in log transportation in this region have a manufacturer's rated capacity of 1½ tons, while very few trucks have a rated capacity of more than four tons. The average load of hardwoods on these larger trucks is 1,200 to 1,400 board feet (Doyle log scale), whereas the 1½-ton truck can safely transport 500 to 900 board feet on a load. By reducing the gear ratio 30 per cent to 40 per cent in first and second gear, and by using over-sized tires, a 1½-ton truck can easily carry 1,400 board feet of hardwood logs, provided, of course, that state laws are not violated. About half of the millmen prefer the 1½-ton trucks, whereas none of the contract log haulers prefer anything smaller than a 2-ton truck. Relatively, very few of either type of operator prefer trailers or semi-trailers.

Trucks are generally loaded by hand from a bank, using spiked skid poles to bridge the gap between the truck and the bank. There are other methods of loading, however, such as using a stiff-leg derrick, cross haul with a team or tractor, or the cross haul method deriving the power from the engine of the truck itself. This truck motor-driven loader includes a power take-off from the transmission, gear shift lever, drive shafts, sprockets and chains, drum and 100 feet of ½-inch steel cable, which must be replaced every two years. The cable comes from beneath the right side of the truck, passes over a pulley and rolls the logs up on the left side of the truck. This loading system is the same in effect as that used with a horse or tractor cross haul. Two skid poles are placed with one end of each on the ground and the other against the truck and at a distance apart which will accommodate the logs to be loaded

[1]Based on a study of 54 trucks on 39 operations where logs are supplied to the small sawmills in several of the northeastern states, chiefly in New York.

The logs are brought to the foot of the skids, the cable is passed over, around and beneath the log at the center and then back to the left side of the truck where the free end is fastened. The drum is set in motion, hauling in the cable and drawing the log up and on to the truck. The drum is loose on its shaft and is equipped with a ratchet which can be disengaged, so that the drum is free to revolve when the cable is being drawn out. When loading logs, the ratchet is used so that even though a drive shaft or other part may break, the log will not roll back down the skids. This device is also used for skidding. This method of yarding was used with the largest logs encountered while gathering data for this report. This special loading equipment costs $200 and, with the exception of the cable, will last indefinitely.

The average time required to load a truck is 26½ minutes. The actual loading time, however, ranges between 20 and 35 minutes, depending upon the size of the logs and the number to be loaded.

The average size of logs transported by trucks was 15.5 inches top d.i.b.[2] and 12 feet long. These logs have a log run of approximately ten logs per thousand board feet by the Doyle scale and 8 logs per thousand board feet by the International scale. The largest log handled was 48 inches in diameter and 20 feet long.

Although some logs are transported more than 50 miles by trucks, over three-fourths of the operators haul their logs between 5 and 10 miles; the average distance of haul of all operators is about nine miles. On such an average haul, the trucks can make five to six trips in an 8-hour day. The average total annual distance traveled by the trucks is 16 to 18 thousand miles.

The logs are generally unloaded by hand, but some of the large mills and woodworking plants use a stiff-leg derrick with cable and tongs. When unloading by hand, the operation of removing the logs from the trucks requires from 5 to 15 minutes, depending upon the size of the load and the number of logs, as well as the number of men assisting. About 85 per cent of the operators use two men, who usually require 10 minutes to unload a truck. The average cost of unloading is 13 cents per thousand board feet.

From one-half to three-quarters of the road distance traveled by trucks is improved and the remainder is of the ordinary dirt type of highway. As occasion demands, however, roads of various types are constructed by operators. These roads are either of the dirt or plank types, the latter being of two kinds. The more expensive plank road is made by laying planks at right angles to the direction of travel. Such planks are laid on two to four stringers which are placed parallel with the road and beneath the truck wheels. This type of construction costs about $1,760 per mile for labor and material, when planks and stringers of low grades are used. The other type of plank road consists of planks laid parallel with the direction of travel. These planks are laid on cross ties which are about a foot apart. If this type of road is constructed with poorer grades of lumber and timbers, the cost is about $1,040 per mile, which includes the price of materials and labor.

Even though there are deep snows, spring rains, and occasional mechanical breakdowns, trucks are operated an average of 260 days each year. Of this time, contract haulers use about 145 days to haul products other than logs or lumber, whereas the millmen use their trucks for hauling other materials only about 35 days a year. Since the main roads are usually kept cleared of snow and do not get muddy, an operator, using a little

[2]Diameter inside bark.

foresight, can reduce the time the truck is idle by hauling during good weather logs only from those woods that are adjacent to the poorer roads.

There are many reasons why trucks are used in preference to other methods of log transportation in the Northeast, but the most important of these are:

(1) Under most conditions trucks are cheaper, especially where improved roads are available.

(2) The speed of delivery with trucks saves time.

(3) Small parcels of standing timber can be purchased without moving the mill, giving flexibility in sources of log supply.

(4) The truck can often go close to the stump or felling area and thereby eliminate part or all of the skidding.

(5) Trucks can be used for log hauling as well as lumber delivery.

(6) Small, permanently located mills are possible because of the low cost of log transportation on improved highways, thereby giving stabilization to the small mill.

Certain difficulties are encountered, however, as follows:

(1) Poor roads[3], resulting in loss of time from decreased speed and temporarily impassable conditions.

(2) Loss of time due to mechanical difficulties.

(3) Adverse grades.

The size of the truck apparently makes little difference in oil consumption, which averages for all trucks about 7 quarts of oil per thousand miles. This amount gradually increases, however, with the age of the truck, until in extreme cases a truck may use two quarts of oil every hundred miles. Similarly, gasoline is used in greater quantities as the age of the truck increases. The gasoline mileage may vary considerably, however, with the size of the truck. The 1½-ton trucks average about 11.5 miles per gallon (both loaded and unloaded combined) whereas the 4-ton trucks obtain only 8 miles per gallon.

Tire mileage is surprisingly high. Tire mileage depends primarily upon road conditions, make of tire, and whether tires are on front or rear wheels. There are also other factors which have a bearing on the life of a tire, such as, number of plies, proper inflation, and weight of the load, but the aforementioned are the most important. On the average front wheel tires last about 34,000 miles; those on rear wheels about 25,000 miles.

When hauling, all the trucks regardless of capacity travel at about 25 miles per hour. On the return trip, however, the larger trucks travel at more rapid speeds. The use of trailers decreases speed both on the haul and return trips. Nevertheless the chief limiting factors are not available speed, but adverse grades, curves, road conditions and state speed laws.

Averaging the costs of all operations where figures were available, it is found that $11.10 per day is the total expense[4] of motor truck transportation of logs under the above mentioned conditions. The variation however between sizes, makes and operators, ranges between $8.00 and $24.00 per day, increasing, other things being equal, with the size of the truck. Despite the total daily charges, the larger trucks haul logs cheaper per unit cost o[f] a thousand board feet, because of th[e] larger loads transported. The averag[e] cost of transporting a thousand board fee[t] of logs, for the average distance of nin[e] miles, is $4.31. These cost figures d[o] not include loading and unloading, no[r] road construction. Adverse grades an[d] road conditions may increase the cost o[f] truck operation 10 per cent to 50 per cen[t].

One of the most important develo[p-]

[3]Including ordinary poor roads and roads made difficult to use by inclement weathe[r].

[4]Includes such items as depreciation, driver's wages, license, taxes, insurance, storage an[d] running expenses such as gas, oil, tires, repairs.

ments, which has been brought about by the motor truck transportation of logs, is the stabilization of small mills. Operators can now locate their mills at advantageous points for labor supply, operation and merchandising the product, with little thought of a timber supply, if merchantable woodlands are available within a radius of 30 miles.

With constant improvement of the existing highways and the further paving of dirt roads, the operation of trucks for log transportation will become increasingly important. The trucks, like the roads, are constantly being changed for the better, so that, as progress continues, trucks will undoubtedly become the most important and best means of log transportation for almost every logging operation in the Northeast.

"If our forests are to perform their permanent function to the community as they did not perform it in the Lake states, we as citizens must insist on stronger and more direct state and federal participation in this forestry program. We must provide that remaining stands be logged on a basis that conforms with the best forest practice for sustained yield. We must support the acquisition by the state and federal governments of lands needed to insure the protection of our common interest in carrying through this great, consumingly important program."

—Editorial, *The Timberman,* Sept., 1934.

RAINFALL AND HEMLOCK GROWTH IN NEW HAMPSHIRE

By CHARLES J. LYON

Department of Botany, Dartmouth College

Foresters are inclined to differ in their opinions as to the relation between rainfall and the rate of growth of trees. The method pursued by this author in his study of annual rings as a measure of rainfall and other climatic variations, his comparison of his method with those of other investigators, and the conclusions he reaches should be instructive and helpful on bringing about a common understanding of the correct viewpoint.

THE rate of growth of a plant is conditioned by its environment and water supply is usually a very important factor. This is the basis of most agricultural and horticultural practises yet in the field of forestry we find differences of opinion as to the controlling effect of annual or seasonal rainfall upon the rate of growth of a tree, as measured by the thickness of the cylinder of wood formed during the growing season. In arid regions it seems to be proved that rainfall is the limiting factor but for humid regions no decision has been reached. The facts reported here are a contribution to the solution of this problem.

The most extensive and intensive study of annual rings as a measure of climate and particularly rainfall has been reported by Douglass (4). Since most of his material came from the more or less arid Southwest, we are concerned chiefly with his methods of handling data and with the limited work which he did in New England. One point not generally appreciated is the insistence which Douglass gives to the use of certain portions of long records from large trees. For example, Burns (2) attempted an analysis of this problem in Vermont but used a period of 12 years (1914-1925) for white pine trees not over 10 inches in diameter. Thus he dealt with growth increments during the infancy period of tree development when its rings are known to be large and "complacent." The latter term is used by Douglass with reference to the general lack of response of growth to single environmental factors during the years of youth. Later on th growth process does respond to extern factors; hence the need to use the ring formed during the mature years. Th usually requires that growth studies b made only with trees at least 100 yea old except where knowledge of the b havior of young stands is the prima object.

Another important point in the critic use of annual rings as measures of cl matic influence is the emphasis to b placed on the use of small increments f cross-dating trees in the same grou The very wide rings may and often c appear in corresponding years but t smallest widths must be spaced esse tially the same in responsive trees. A though this point would seem to be mo important for the secondary uses cross-identification, it is fundamental all decisions as to the faithfulness of t records of individual trees. When the is any need for choice of records to used as representative and normal, su choice must consider the sequence a spacing of narrow rings as they appe between average or wider rings. Indivi uals which fairly represent a group mu show the same distribution of narr rings.

This principle rests on the sou physiological argument that a tree w not respond precisely to a factor su plied in optimum or maximum degree even one other essential factor is defici at the time. Thus, water may be abu dant while low temperature retards sorption of nutrients or synthesis of foo However, if the essential factor in qu

ion (water supply in this study) is de-icient in amount, all trees to be used is measures of climatic effect should show i retardation in growth at that point. f any one does not, it may safely be as-umed that either its responses or its norphological relationships with the en-ironment are unusual. It may better onserve its water supply or its root sys-em may reach a special source of mois-ure. On the other hand, when two or nore members of a group of trees on a iven site show definite capacities for uch cross-identification, one is justified n the claim that they measure the re-ponse to controlling factors of climate. Data sufficient to provide mean values vith small probable errors are desirable out the means of the annual increments of a few responsive trees are more sig-ificant than those of many trees of un-ertain response.

A final point to be noted in this work of seeking relationships between climate and rate of growth is that "highs" and 'lows" are used for cross-identification and as indices, such as supplies of water and favorable temperatures. This is far rom an attempt to work out a quantita-ive relationship between growth and a ingle environmental factor. For exam-ple, it is not the intent of experienced tudents of the subject to say that a cer-ain number of inches of rainfall are equired to grow a cylinder of wood 1 nch thick on a tree of a certain size. The complexity of the problem makes his impossible.

The results reported by Douglass for New England are summarized in one of is books (4, pp. 41-42, 79-80). In brief e found that old hemlocks near Wind-or, Vermont could be cross-identified ut that they did not reflect the rainfall f the region as measured at Hanover nd Concord, N. H. Pines in eastern Aassachusetts are said to be even less atisfactory in their responses, perhaps

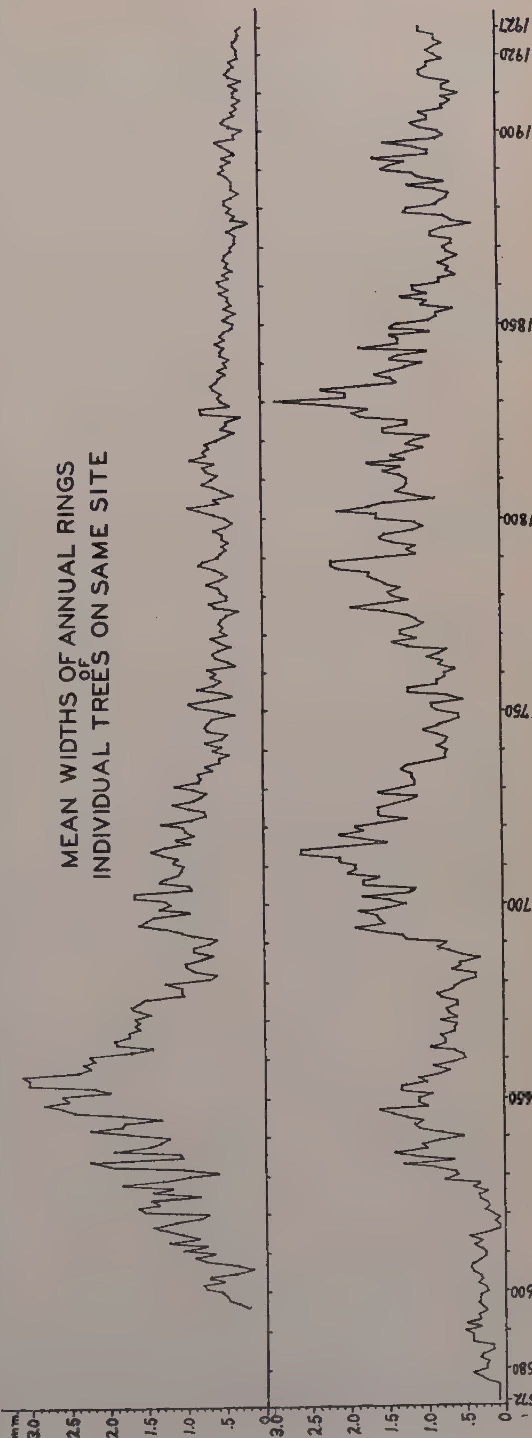

Fig. 1.—Hemlock growth rates at Wakefield, N. H.

because of intensive cultivation in their vicinity.

The conflicting results of other workers are outlined well by Burns (2, pp. 3-5) and for our purposes it is unnecessary to review the papers in detail. Many of them deal with analyses made in other parts of the world and some of them can be regarded as less important than others because of objections mentioned in preceding paragraphs. In summary, we may state that the findings of Bogue (1), Robbins (8) and Marshall (7) support to some degree the idea of a dependence of growth on precipitation while those of Concord (3), Hansen and Brenke (5), Hartig (6) and Shreve (9) emphasize other factors or the sum of all factors. No facts have been obtained for New Hampshire forests and the subject is clearly in need of more data and of more careful analysis.

Materials and Methods

The wood sections for this study were obtained from a cutting of virgin pine and hemlock timber in Wakefield, N. H., where a few trees were cut in June, 1928. Some of the trunks were hollow and only two complete sections, both of hemlocks

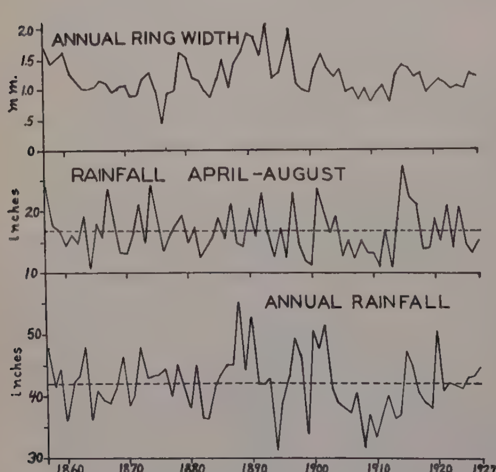

Fig. 2.—Relation of growth to rainfall

solid to the center, were available fo analysis. Thus the choice of trees wa entirely at random except for selectio of unrotted wood. The sections wer dried, smoothed and the widths of ring measured *along 3 average radii* each, b means of a 10-power dissecting binocula with a graduated measure in one ocular

It is felt that this method of measure ment overcomes certain objections whic can be made to the use of cores fron living trees or to the use of measure ments along a single radius. The dat bear out these objections. No singl radius has the same sequence of narrov and wide rings as the averaged radius The mean width is clearly a better inde of growth. Precautions were also take against rings wedged-out on one side o the section though no such rings wer present in these trees. Not only did th number of rings prove to be the sam along each radius of one tree, but check made at intervals of 50-60 years prove the regularity of ring formation through out each section. The possibility that a entire ring may be missing at the leve at which the section is taken is small an smaller still that this should occur fo both sections. The check on this chanc appears in the cross-identification of th two graphs for it is practically impossib that two trees chosen at random shoul show this missing ring in the same yea Finally, the influence of local flares o the outer rings was avoided by suitab choice of the three radii.

To compare the data for the two con plete records (one for 332 years and t other for 356 years) the 3 measuremen for each annual ring were averaged a the means plotted as ordinates again the year of growth of the ring. Since t 1928 ring was barely started at time cutting, the outermost ring was dat 1927 and for comparison of the tw growth records, the graphs were set t

gether as shown in Fig. 1. No attempt has been made to correct for "gross rings," for the suppression shown by the older tree when it was clearly held back for the first 50 years, nor for the fact that the section of this older tree was cut so low that the general flare of the base made all measurements after the first century larger than those of the other tree. The resemblances between the two graphs are so obvious that such corrections were unnecessary, since it is the occurrence of highs and lows, and especially the latter, which shows how the trees responded to climatic fluctuations. Since both did respond well and in most years in the same way, they can be used for analysis of the relationship of hemlocks in that forest to such a factor as rainfall.

The data for precipitation in the area was obtained from the weather bureau records kept at the Lakeport, N. H., cooperating station, about 20 miles away. Fortunately both the station and the forest site lie at the same altitude and in the same basin (on opposite shores of Lake Winnepesaukee) and will have similar rainfall conditions. The records are available by months and in addition to the annual rainfall for calendar years, we have considered the "summer" rainfall as a factor which merits equal consideration with the usual form of annual record. The months chosen for this calculation were April to August inclusive. Frozen ground through March and practical cessation of growth by September were the deciding factors in the effort to select the period during which precipitation would actually affect the moisture content of the soil in the forest during the growing season.

This data for annual and "summer" rainfall is plotted in Fig. 2 along with the combine growth of the two hemlock trees for the same years. Although the weather bureau records date back to 1857, this period is only a fraction of the life of the trees but at least for these later years there is a close relationship between growth increment and the water supplied during the growing season. In some cases the connections are very close, as during the summer drouth years of 1876, 1894, 1898-1900 and 1905-1913, the latter period being followed by the relatively wet summers of 1915-1917 when the trees grew more rapidly. Other positive responses to abundant precipitation will also be noted for 1874, 1897 and 1901-1902.

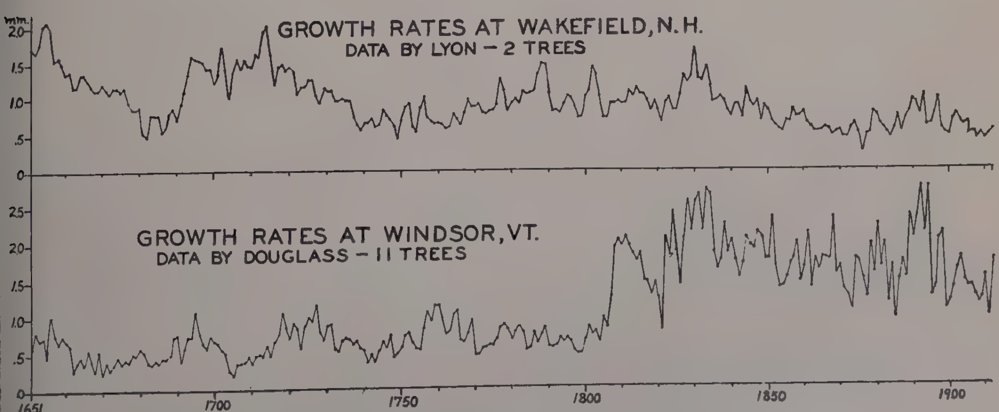

Fig. 3.—Hemlock growth in New England

Results

There is little need to elaborate on the conclusions to be drawn from these two sets of data as presented in graphic form. The two trees are evidently correlated in their growth rates for nearly 3 centuries, some allowance being made for the first 50 years of the younger tree when its complacent rings are not to be matched well with the suppressed growth and complacent rings of the older tree. There are not only the striking cases of lows in individual years, such as 1876, 1749, 1681-1682 and even 1640, but the extended periods of retarded growth in both 17th and 18th centuries with less well defined ones in the 19th and 20th centuries, show well in the records of both trees. Individual lows might be passed over as seed-years were it not for the correlations shown in Fig. 2 with rainfall but the only explanation for the extended periods of retarded growth lies in an unfavorable set of climatic factors. Since the correlation with sub-normal rainfall is evident in Fig 2, it seems fair to regard the periods of retarded growth as long drouths, though a secondary effect of other factors is not precluded.

In connection with other possible factors, that of temperature gets an excellent test in the year 1816 which has long been famous as the year without a summer. The hemlock growth record fails to show anything unusual that year.

Opponents of the general method of cross-identification between trees attach much importance to variations in growth up and down the trunk, in addition to the variations which are avoided by our precautions against incomplete rings and the effects of eccentric growth. The existence of these vertical variations is not disputed here but their relative importance is offset by the insistence upon use of tree records which over many decades
show good cross-identification in year
when some factor or set of factors re
tards growth. The measurement of growtl
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hemlocks indicates a contradiction of th
opinion of Burns (2, p. 5) that thes
variations "all show the futility of at
tempting to correlate rainfall with dat
obtained from stump analysis." The sam
writer (p. 6) admits that "One of th
chief factors for plant growth is th
available moisture in the soil" and th
problem resolves itself into correct meas
urement of both growth and availabl
water supply.

In addition to the correlations shown i
Fig. 2 and mentioned above, these direc
relationships between effective rainfal
and tree growth for a period of 70 year
impel us to look back of 1857 for evi
dence of other marked drouth years o
periods. These are easily noted on th
graphs. In the total absence of rainfal
or other records of climatic factors fo
New Hampshire for these 2 centuries, th
only other method of showing that th
years or periods of retarded growth rep
resent a general adverse climatic effec
as opposed to a local effect in the Wak
field forest, is to match this growth re
ord with comparable records in nearb
sections of the same climatic zone. Th
opportunity for such a comparison
afforded through the published records
Douglass (4, pp. 78-79, 116-117) for h
studies of hemlocks near Windsor, Ve
mont. Here it is advisable to use a con
posite graph for comparison with th
same type of graph given by Dougla
for 11 trees. Both graphs are shown i
Fig. 3 for the period covered by th
Windsor record which is shorter on bo
ends than the Wakefield record.

These composite graphs for tree growth appear to cross-identify as well as one could expect. The severe depression of 1655-1690 and the less pronounced one of 1730-1755 are both evident along with several other depressions of shorter duration (e. g., 1790-1799). Many single or double years with marked lows on both graphs can be found (see 1762-63, 1798-99, 1821, 1845-46 and 1853-54), while even more miss perfect correlation by one year. There are also several excellent correlations with maxima (1751-52, 1833, 1844 and 1874). Although the relationship between these two graphs is not as obvious as that between the two in Fig. 1, it is still evident and taken by us as proof of a similar set of climatic factors affecting tree growth in the two regions represented, with rainfall during the growing season as the probable dominant factor.

In connection with the use of these two graphs of independent origin, it must be pointed out that even a less perfect correlation would be significant. Our two trees grew side by side but the eleven from Windsor were taken from two sites and the single composite graph was made in spite of certain pronounced differences between the two groups of records. The growth records of the Vermont trees are based on measurements along a single radius as opposed to the mean values along 3 radii for the New Hampshire trees. These differences are quite sufficient to account for the cases in which the lowest or highest point in a group of low or high measurements fails by one year to match perfectly with the corresponding point on the other graph. It will also be noted that the scale, on which the widths of rings are plotted, is large and tends to emphasize the differences involved.

Finally, it must be noted that the rainfall and soil moisture conditions for Windsor and Wakefield are probably not the same in detail. The two places are 75 miles apart. Two sites are involved at Windsor, one on the lower slope of Mt. Ascutney and the other 7 or 8 miles to the east across the Connecticut Valley. No good rainfall record for this section is available because the precipitation varies greatly thereabouts, as shown by marked differences between Woodstock, Vt., Hartland, Vt., and Hanover, N. H. All these stations are within a 20-mile radius of Windsor but the second (and nearest) has a consistently greater rainfall than the third, as indicated by a short record of 14 years for Hartland. This record includes the two drouth years of 1894 and 1899 (cf. Fig. 2) and there are decided differences between the three stations as well as between them and Lakeport, N. H., for these critical years. The failure of Douglass to obtain a correlation between growth rate and precipitation seems therefore to have been caused by lack of suitable data for the water supply of the Windsor forest sites. The cross-identification, based largely on small increments of drouth years, with hemlock growth records in New Hampshire furnishes new evidence for a good correlation between hemlock growth rates and rainfall of the growing season.

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Up to a few years ago, large forests could be found in Europe where the foresters had written orders forbidding them to do any thinning. Many theorists and also practical men still hold the opinion that the best forest products, knot free and cylindrical, are obtained from the uniform high-forest in close formation. Other foresters refer to the fact that a certain part of the trees in virgin forests gives the very best quality, and that we ought to learn and can learn from the virgin forest how to procure that fine quality.—*Scottish Forestry Journal.*

CAPE COD PITCH PINE: ITS RESISTANCE TO GIPSY MOTH DEFOLIATION AND ITS ADVANTAGES AS A FOREST TREE

By RALPH C. HALL

Central States Forest Experiment Station

THE gipsy moth (*Porthetria dispar* L.) presents the major forest insect problem on Cape Cod at the present time. From the standpoint of its destructiveness, it could well be classed with fire. Dead oaks all over the Cape offer mute evidence of its work in the past, the oak group appearing to be more severely injured than any other group of deciduous trees. Foresters, entomologists, and others who are acquainted with the Cape, have observed in the past that pitch pine has suffered only to a slight extent from defoliation by the gipsy moth. It is very common to find thrifty pitch pine trees growing in areas where all the deciduous trees have been killed. While pitch pine, which is equally as picturesque as a roadside tree, requires no spray protection against the gipsy moth, oak is a constant source of expense in this respect.

As a result of the foregoing observations, a study of the relative resistance of pitch pine to gipsy moth defoliation was conducted during the early part of September, 1932, by the Division of Forest Insects of the Bureau of Entomology, U. S. Department of Agriculture. The writer carried on this study in coöperation with the Gipsy Moth Laboratory at Melrose Highlands, Mass., and the Harvard Forest, Petersham, Mass. During this study an attempt was made to determine to just what degree pitch pine suffered from defoliation by the gipsy moth. Owing to the fact that the study was conducted during the latter part of the growing season, and at a considerable length of time after the larvae had completed their feeding, it was necessary to depend to a large extent upon the assistance of local men in locating areas of complete stripping. The deciduous trees had refoliated, and often the only evidence of attack was a thinner appearance of foliage, along with the presence of egg clusters and pupal skins. Mr. Lincoln Crowell, District Forest Warden, and Mr. Samuel King, Cape Cod Ranger Patrol, members of the Massachusetts Department of Conservations, gave invaluable assistance in the location of such areas upon which to carry out the study.

An attempt was made to find a variety of areas upon which heavy feeding had taken place, and where pitch pine was associated with many other tree species. Among these were white, Scotch, and red pine, European larch, Norway spruce, and hardwoods consisting of scarlet, black, white, and scrub oak, beech, soft maple, hickory, and holly. In addition a comparison was made of the rate of growth of pitch pine on areas which had been completely stripped with that on areas on which no feeding had taken place.

The results of this study demonstrated that from a standpoint of damage by the gipsy moth, pitch pine is far superior to any other common native tree species on Cape Cod. No feeding was observed on holly, which is comparatively rare, nor upon southern white cedar, which occurs only in swamps. Pitch pine appears to be more resistant than any of the introduced coniferous species, with the possible exception of Scotch pine.

Gipsy moth defoliation on the Cape during the season of 1932 approached the heaviest in the history of its invasion.

It was felt by some observers that the defoliation was even heavier than the one that occurred in 1926. Mr. Samuel King reported that in the town of Sandwich alone, 5,000 acres were completely stripped by the insects. In some areas the stripping included the ground plants as well as tree species.

It appears from the results of this study that the gipsy moth prefers the foliage of hardwoods to that of pitch pine, and will feed on the latter only when all other available food is exhausted. Whenever the gipsy moth is driven through necessity to feed upon pitch pine, it first eats only the old needles, and only in very exceptional cases will it feed upon the new growth. Mr. Lincoln Crowell's theory concerning this is that during the early growing season the young pitch pine needles are still enclosed in their long needle sheaf, and are protected in this manner. The writer has never observed feeding upon pitch pine, but this sounds like a plausible theory.

Pitch pine on Cape Cod retains its needles only about two years. Illick mentions that in Pennsylvania only 1 per cent of the needles on pitch pine are more than 1 year old. It would seem from these results that defoliation by the gipsy moth would mean a reduction of only about 50 per cent of the leaf area.

Fig. 1.—Pure stand of 70-year-old pitch pine on Mashpee Neck.

For this reason, removal of second-year needles probably is not nearly so important as would be the removal of the current year's growth, but until we have definite information on the relative amount of food that is elaborated by first and second year needles, no conclusion can be reached.

In the case of white and red pine and spruce, the gipsy moth feeds upon both the new and old growth, and this is probably the main reason that feeding on these species is more harmful than on the pitch pine.

Whenever pitch pine and white pine are found associated, the gipsy moth prefers the foliage of the white pine. One complete defoliation of a white pine may bring about death.

When European larch and pitch pine are in association, the gipsy moth appears to prefer the foliage of the former. No areas were observed where complete stripping of larch had taken place, but in two plantations feeding was so heavy that practically all the needles were killed, and the result was the same as complete defoliation.

Only two red pine plantations were observed in areas of complete stripping. One of these had been sprayed, and had suffered no injury. The other one, however, was completely stripped, and practically 100 per cent of the trees were killed. The fact that it was located on a very poor site may have contributed to a certain extent in bringing about death. In practically no case had any of the trees refoliated after this stripping. There were a number of native pitch pines scattered through this plantation. There had been heavy feeding on some of them (a considerable number of young needles eaten), but in no case had any of them been killed.

No plantations of Norway spruce and pitch pine were observed. In the case

of a few ornamentals, complete stripping had taken place, resulting in death, while little or no feeding was observed on adjacent pitch pines.

Aside from its resistance to gipsy moth attack, pitch pine has many advantages over the other tree species of the Cape. The only other primary insect of any consequence is the Nantucket tip moth, which is quite common on the Cape, and causes some damage to pitch pine. Owing to the fact that adventitious buds are formed directly beneath the portion of the tip that is killed, only a few inches' loss in height growth results.

Pitch pine seems well adapted to the light, sandy soils of the Cape, and with very few exceptions will grow more rapidly than other species with which it is naturally associated. While white pine is an exception and will make more rapid growth in early life, it has the tendency to die out in the top after it reaches about 50 years of age.

Although Scotch pine appears to be equally resistant to gipsy moth attack, pitch pine has many advantages in its favor. It is only on the better types of soil that Scotch pine surpasses it in rate of growth, and Scotch pine has a tendency to deteriorate after it has reached an age of about 40 to 50 years. One notable example of this is a 50-year-old Scotch pine plantation at South Orleans, in which the major part of the stand has died out, especially in places where it does not enjoy protection from other trees. Adjacent pitch pine of approximately the same age shows no deterioration, and is still putting on height and diameter increment.

From the standpoint of its resistance to fire, pitch pine is admirably adapted to the Cape, where fires are a rather common occurrence. Owing to its exceptionally thick bark, it is one of the most fire-resistant trees in the eastern part of the United States. It cannot, however, withstand crown fires, which are responsible for practically all fire-killed trees. Its ability to sprout after being killed by fire gives it a decided advantage. Much of the present-day pitch pine forest of the Cape is of sprout origin, owing to the occurrence of fires.

Pitch pine is also well adapted to growth on Cape Cod owing to its high resistance to damage by wind-driven salt spray. During the severe northeastern gale on September 8, 1932, salt spray was deposited on vegetation at distances as great as 6 miles from the shore. In the immediate vicinity of the shore, the leaves of practically all ground plants and many trees were killed. The foliage of pitch pine showed only a slight burning, and in no case did death result.

Pitch pine reproduces itself remarkably well on Cape Cod, on all areas where there is an absence of dense ground cover of huckleberry or blueberry. The latter two species often occur so densely as to prevent the establishment of pitch pine seedling reproduction. Dense mats of these two species are usually associated with repeated fires, but in such cases pitch pine sprouts are usually found in abundance. Seedling reproduction is usually abundant in cut-over areas where the ground cover is sparse. Abandoned fields, pastures, and cranberry bogs also offer excellent seedbed conditions.

Advance reproduction of pitch pine occurs quite commonly on the Cape on areas that contain a fairly high proportion of oaks in mixture with pine. This is a rather fortunate condition in areas where all the oaks are being killed by the gipsy moth.

Contrary to the general belief that the pitch pine forests of the Cape are largely scrub growth, most areas in which no fires have occurred are producing well

stocked, thrifty stands of timber (Fig. 1). While it is unlikely that timber production on the Cape will ever be a very important industry, owing to the comparatively slow growth on the light sandy soil and the prevalence of fires, it seems apparent that the indirect benefits of the forest will be increasingly important.

In summing up the advantages of pitch pine as a forest and roadside tree on Cape Cod, we find the following factors to be of importance: Pitch pine has few primary insect enemies; it is fed upon by the gipsy moth only after all other more palatable species have been eaten, and then the current year's needles are rarely attacked; pitch pine is very resistant to fire and to salt spray damage; it reproduces itself abundantly on the Cape, both by seedlings and sprouts; under the site conditions prevailing on Cape Cod it appears to be much longer lived than other species with which it is associated, and its rate of growth compares favorably with theirs.

The best (Spanish) cork generally comes from the trunks of trees of from 60 to 80 years of age, but material of corresponding quality will be obtained from the branches of older trees. Really good cork is not more than an inch or so in thickness, but bark up to 2 inches or even more in thickness will be taken off.

The actual operation takes place during the "rise of the sap," which lasts from June to August, the earlier the better, and the healthier and stronger the tree the more bark can be removed. The first stripping produces a rough, inferior material technically known as "virgin" cork of no value to the wine or similar trades. It may be used for tanning purposes, for grinding into "granulated" cork, or for conservatory or fernery work. This stripping is followed by a second of slightly better value, the cork obtained being largely used for fishing nets and similar purposes. After that the quality of the cork tends to improve on each stripping, which is done at intervals of from seven to nine years.—*Quarterly Journal of Forestry* (English).

BRIEFER ARTICLES AND NOTES

Changes in Timber Requirements of the Oil Industry

Editor's Note:—The author describes briefly in the following letter the trend of events as they have worked out in the Texas Company's attempt to establish a forest property to be managed on the basis of a sustained yield to meet their lumber requirements for case oil shooks and wooden barrels.

"As I saw conditions at that time, in 1919, we had an ideal set up for the practice of private forestry on a sustained yield basis with all the niceties of technical skill and management that one may care to undertake.

"In the first place we had an annual requirement of lumber varying from 30,000,000 to 100,000,000 feet per year definitely settled at 60,000,000 feet per year.

"Secondly, we had sufficient funds to purchase the correct forest properties to yield this annual cut to be managed on a sustained yield basis.

"In other words, such forest lands were for sale, we had sufficient funds to acquire them and our people were sufficiently 'forestry minded' and willing to establish the proper personnel and equipment to handle on as intensive a scale of management as necessary.

"With this object in view, we acquired by 1924 approximately 600,000,000 feet of merchantable timber on 60,000 acres of land carrying sufficient near merchantable timber of varying age classes to make a fine beginning for sustained yield management.

"My secret ambition at that time was to furnish the profession with an example of a properly managed private forest property actually working on a sustained yield basis. In addition, I had hoped to make a sufficient showing so that our people would be willing to entertain the matter of applying proper forest management on their prospective oil lands now carrying timber of various sorts, conditions, and ages. Being a major oil company, such holdings are quite large. Such lands, properly managed should at least pay carrying charges until needed for oil development.

"Unfortunately, the following conditions came about which have done away with all my high cherished ambitions along forestry lines and have changed my efforts of a practicing forester to that of converting a potential regulated forest back into money.

"1. A world-wide decline of business and thus a reduction of our requirements for lumber.

"2. A change in the foreign demand for boxes. Our empty boxes in foreign countries lost their resale value as shipping containers to be returned to this country with other products or used in those countries for this purpose. Bulk shipments and substitute containers have done away with this demand for wooden boxes.

"3. Our lumber requirements for domestic shipments in this country were until 1932, approximately 10,000,000 feet per year. Paper boxes have reduced this requirement to practically nothing. We use no wooden box for shipments of 50 lbs. and less per package. The paper box people are now putting out a very satisfactory box that will take 100 lbs. It is needless to say that the price of

paper cartons and boxes are about one-third of the cost of similar wooden containers.

"4. The tax revenue requirements in those communities where our timber properties are located are so heavy that the matter of annual taxes makes it almost prohibitive to carry such properties indefinitely. This is especially true where most of the timber lands belonging to others have been denuded.

"5. Our lumber requirements now are 15,000,000 feet b.m. per year and are getting smaller.

"As a result of the foregoing, we are selling and cutting our timber as fast as conditions will permit. The unfortunate part is that in selling we cannot get back our carrying charges and in cutting we simply convert the original price paid for stumpage back into money because present lumber prices are so low.

"In 1920 we purchased about 12,000 acres of the excellent white oak timber in the Ozark region of Arkansas, the purpose of which was to lay a foundation for the acquiring of more of such lands to protect us in our wooden cooperage requirements. We were paying about $4.00 per barrel at that time. Six months after acquiring this property, the steel people came out with what is known as a "one trip steel drum," costing less than $2.00. Our wooden barrel requirements were solved—not by owning and managing timber lands.

"Prohibition remained in force until recently and nobody wanted high class cooperage timber. After carrying this property for 13 years, through good salesmanship we sold it for the original purchase price. We did not realize taxes and interest and a caretaker at about $100.-00 per month. Sort of discouraging, isn't it?

E. J. Heller,
Forest Engineer for the Texas Co.

Release of Young Norway Pine from Aspen Competition

The C.C.C. Camps have made a large number of release cuttings in northern Minnesota. What is the value of such cuttings, and what effects may be expected as a result of them?

One answer to these questions is found in the results of release cuttings in the Birch Lake Norway pine plantation on the Superior National Forest. This plantation was established in 1915. A fire which burned off all vegetation had occurred the previous year. The plantation is a little over a hundred acres in extent. Various ages of stock were used but all were transplants, 2-1, 1-1, and 1-2. The trees were spaced 8x8 feet or 680 trees to the acre. After planting no care was given the area.

In 1931 the station made an examination of the area and found that although pine still predominated on one-fifth of the area, aspen and brush had completely claimed one-fourth of the plantation and over half was a mixture of aspen and pine.

In the same year a release cutting experiment was established in the area of mixed aspen and pine, where aspen suckers to the extent of 1400 per acre had grown up and due to their large size were affording considerable competition to the planted pines. At this time there were about 375 Norway pines per acre, which ranged in diameter from 1 to 5 inches and in height from 9 to 28 feet. On one-quarter acre 380 aspen per acre were cut and only the thriftier pines were released. On another quarter acre every planted tree was released, necessitating the cutting of 800 aspen per acre. A third plot was left uncut for comparison.

In 1934, or three years later, the plots were remeasured to determine the effect of the removal of the aspen competition. The diameter growth in the heavily released plot was found to be nearly two and a half times as great as on the check plot and

nearly one and a half times as great as on the lightly treated plot. The trees which were suppressed at the time of cutting on the heavy release plot responded so well that they grew in diameter almost as fast as the dominant trees. The height growth was similarly affected but to a lesser degree than the diameter growth.

The heavy release cutting is by far the most effective, both as regards the growth of each individual pine and freedom from future aspen competition. In the moderately released plot some pines are still suppressed and will probably die within a few years.

LAKE STATES FOREST EXP. STA.

THE OLD ORDER CHANGETH

Eight years ago an editorial with a somewhat similar title appeared in this JOURNAL. Then reference was to the displacement of a professional politician by a professional forester as the director of a state conservation department. The forester "resigned" after ten months; evidently he had believed the campaign promises of the successful candidate for governor, that conservation would be taken out of politics!

Nevertheless, the editorial was correct —the old order was changing, and for the better. Technically trained men in that state and elsewhere are receiving more voice in determining public conservation policies and those policies are being formulated with more regard for effective service than heretofore.

Then, too, professionally trained men, in that state and in many others, appointed upon merit by a previous administration are now all retained by succeeding governors. Recently, too, another state promoted a technically trained man from the ranks to the directorship of its conservation department. So not only does partisan politics to the detriment of public service now play a much smaller part in the conservation of natural resources than heretofore, but the security of employment and the possibilities of advancement offered to the trained public employee has generally held the personnel intact in the face of salary reductions and opportunities elsewhere.

But these are not the only changes that are taking place. Gradually, the realization is growing that college trained men can be both scientists and practical administrators. Formerly relegated to out-of-the-way corners to solve out-of-the-ordinary problems, young college trained men are proving excellent field men. They are solving practical problems with dispatch and with accuracy never approached by the average so-called "practical" man. Usually, the practical man even after years of experience is pathetically limited in grasping any but the rough and tumble technic of the job.

The excuses for the employment of younger men without technical training in supervisory capacity are no longer tenable. The burden of proof is upon the young man who today aspires to an executive position without such a training. The alibi of lack of time or money are now just prima facie evidence of fundamental defects in character. Educational opportunities are within the reach of all who have sufficient stamina.

It is not only the recognition of training that is coming to the fore, but also the effectiveness of youth as compared with age. The virility of youth is making possible the oldster's "impossible," and so the younger age classes are gradually acquiring a greater voice in conservation affairs. Last spring a proposed forest nursery site was just a scrub oak barren; this fall 10 million seedlings were shipped from this nursery, next year over 100 million production is expected—a signal accomplishment of young foresters. Generally, C.C.C. camps with a young pro-

fessional personnel have far out-stripped in quality and quantity of work performed camps supervised by older practical type of men.

Finally, the old order is changing rapidly in its moral concept of natural resources. Contentment for all people is the paramount national consideration, and foresters generally realize that the conservative use of the nation's heritage must play an important part in attaining this aim. They realize too, that the laissez-faire principle as applied to these resources has failed utterly.

While some older foresters still ponderously demand economic proof of success, a younger generation of foresters have seen the full vision and the implication of forestry as a social problem; they refuse to be stampeded by figures in red ink, demanding only that the project appear socially desirable from a long range point of view.

So the old order changeth from back slapping politicians to technical knowledge, from the over-cautious action of maturity to the aggressiveness of youth and from the concept of individual opulence to that of mass contentment.

P. A. Herbert,
Michigan State College.

Koa Reproduction After Fire

It is well known that the seed of the Hawaiian koa tree (*Acacia koa*) remains dormant in the ground for many years and retains its viability for a long time. It has also been observed that a fire passing over the ground hastens the germination of koa seed.

Observations on the abundance of natural koa reproduction secured in this manner were made on November 27, 1934, in the Pupukea Forest Reserve on Oahu where a fire three months previously had swept over 122 acres of forest land covered largely with a heavy mat of staghorn fern which was interspersed with trees of the native koa and other scattered native trees such as lehua, ahakea and sandalwood.

The staghorn fern was almost completely destroyed by this fire. A mat of decayed fern roots and stems remained in places unconsumed but wherever the mineral soil was exposed young koa seedlings, resulting from the seed in the ground whose germination was hastened by the heat of the fire, started to come up in the vicinity of old koa trees soon after the fire.

One month after the burn these seedlings were an inch high. Three months after the fire they ranged in height from 4 to 11 inches, averaging around 5 inches.

A count was made of these koa seedlings on representative areas by laying off strips one foot wide and 10 feet long and counting the seedlings on each square foot in the region between the old engineers' camp and Pulai Trig. Station. The seedlings on a total area of 250 square feet were enumerated in this manner.

It was found that the seedlings varied from none to a maximum of 17 per square foot with 824 seedlings on 250 square feet or an average of 3.296 seedlings per square foot. At this rate there would be 143,573 koa seedlings per acre were this reproduction uniformly scattered over the area. The young seedlings, however, are found only in the vicinity of the old koa trees but these are scattered uniformly enough to insure a satisfactory new stand of young koa over most of the burned area.

C. S. Judd,
Territorial Forester.

A Plotting Board as an Aid in Analyzing Quantitative Data

Quantitative data in the raw are of little use to the layman. The figures

must be grouped, rearranged and reduced before they are ready for use. Most of us are confronted at one time or another with the job of seeking law and order out of a mass of figures. If one is gifted with a multi-dimensional mind and uses "shrewd judgment" he might come close to the probable answer; if he is not so gifted he will welcome devices and methods designed to make easier the task of summarizing his data. A plotting board to show 3-dimensional relationships offers one such device.

A plotting board consists of a surface into which peg holes have been bored at equal distances apart in a manner to resemble familiar cross-section or graph paper. The surface may be a table top or one side of a packing box. Pegs of several different lengths and a ruler complete the equipment for the plotting board. Colored crayons, to be applied to the tops of the pegs to indicate the relative weights of the points, are sometimes found useful.

In using the plotting board the two directions on the flat surface provide for two independent factors and the height of the pegs above the flat surface for the third or dependent factor. Thus, tree volume as shown by the length of the pegs can well be pictured for various different combinations of tree diameter and height. To illustrate the aid that a plotting board is capable of giving, an example is taken from a naval stores study:

Gum yield, for the first day following chipping, when set up on the plotting board for various soil and air temperature combinations, exhibited a warped surface effect. The relationships were not only curvilinear but changed in form depending upon the combination of soil and air temperature. Such changing relationships are commonly called joint relationships. About the only practical way of smoothing out the irregularities of joint relationship data is by subgrouping and averaging, then smoothing over first one independent variable, then another. For the same degree of accuracy, this requires many more measurements than if the smoothing could be done by multiple curvilinear regression. Furthermore, it is awkward to try to include more than two independent factors simultaneously. A change in the manner of expressing the factors sometimes will convert the relationships to the multiple type. Close scrutiny of the joint relationship often results in a suggested method to accomplish the change. This is where the plotting board serves its chief function.

It was noted that whenever soil temperature was within the range of 10 degrees above to less than air temperature, considerable upward slope in the direction of soil temperature increase was shown by the surface formed by the tops of the pegs; a much smaller slope resulted when soil temperature was in excess of 10 degrees higher than air temperature. By changing the soil temperature factor from an absolute value to a deviation from air temperature the joint relationship was avoided and the data were smoothed by multiple regression along with two other factors affecting gum yield. As the plotting board made it easy to visualize, it was the position of soil temperature with respect to air temperature that formed the basis of soil temperature influence.

The plotting board made the task easier to detect the joint relationship and pointed the way to avoid it. Without the plotting board the same end could not have been reached as quickly or as easily, if indeed, the same end could have been reached at all.

V. L. Harper,

Southern Forest Exp. Sta.

Foresters in "Who's Who In America"

A rather hasty examination of the 1934-35 edition of "Who's Who In America" shows that some 50 foresters are included among a total of 31,081 persons listed in this volume; not a very impressive percentage for an American profession which may be said to be over 35 years old! By Who's Who's standards, the profession of forestry surely ought to be better represented, when there are over 2,100 members of the Society of American Foresters, and it is claimed that there are over 4,000 Americans eligible for membership in the Society; there are surely more than 50 prominent professional foresters in the United States! Is this small representation in Who's Who due to a lack of pride in their profession, modesty, or just plain inertia?

As might be expected, the professors of forestry lead in this volume with 23 representatives; federal employees follow with 13 (10 in the U. S. Forest Service), 11 from general fields (3 living abroad); 5 with associations, and 2 state foresters.

Geographically, 38 of these foresters are from eastern states, 9 from New England alone, with 7 from the Pacific Coast and the Inland Empire. As to colleges, Yale leads with 30 men, Cornell has 5, with several other colleges represented.

"Who's Who In America" has been issued biennially since 1899, the latest being Volume 18. It claims to be "A biographical dictionary of notable living men and women in the United States," and "aims to give a brief, crisp personal sketch of every living American whose position or achievements make his personality of general interest, and tells just the things every intelligent person wants to know about those who are most conspicuous in every reputable walk of life." Volume 18 contains 2,749 pages, has 31,081 sketches (1 person out of every 3,960, based on 1930 census population data), of which 3,030 are new inclusions. The book is a valuable reference work for libraries, schools, colleges, etc. Certain names are included automatically, such as the President, the Cabinet, Congressmen, all federal judges, governors, all American ambassadors, foreign ambassadors to this country, college presidents, many deans of colleges, all officers of the Army above the grade of colonel and all of the Navy above captain, all bishops, prominent authors, actors, and artists, etc. Eligibles are divided into two classes—1. those especially prominent in creditable lines of effort, making them of extensive interest, enquiry or discussion in this country; and 2. those included on account of their official positions—civil, military, naval, religious, educational, etc.

It is understood that admission is by invitation only. The editors state that not a single sketch in the book has been paid for—and none can be paid for.

John D. Guthrie,
U. S. Forest Service.

Errata

In the December, 1934 Journal, the following correction should be noted: p. 946, 3rd paragraph should read as follows:

"They (the foresters) have got to get over their inferiority complex and they have got to do it competently and gracefully. . . . A social status never is gained by demanding it—at least not in words. It is gained first by deserving it and next by intermingling a certain amount of hooey into our daily attitudes."

In the January, 1935 issue of the Journal, the following correction should be noted on page 80: Table 2 should read Table 1.

REVIEWS

Ecological Relations in the Pitch Pine Plains of Southern New Jersey. By Harold J. Lutz. *Bull. 38, School of Forestry, Yale Univ., New Haven, Conn. 80 pp., 18 figs. 1934. Price 90c.*

The extensive area in the coastal plain region of New Jersey, known as the "Pine Barrens" has been the subject of much discussion and speculation. Most of the speculation has been due to an effort to determine the underlying causes of certain very unusual ecological conditions prevailing on several areas within the Pine Barren region known as the "Plains." These areas support a low growth of pitch pine (*Pinus rigida*) sprouts and scrub oak (mainly *Quercus ilicifolia* and *Q. marilandica*) which seldom reaches a height greater than 4 to 6 feet. The general aspect of these so-called "Plains" has, according to tradition, remained practically unchanged for two centuries.

Geologists, ecologists, and foresters have freely advanced explanations in their effort to account for the apparently static condition of the "Plains" areas. It has remained for Lutz to make the most thorough investigation and consequently to give the most satisfying answer to the riddle. He left no stone unturned in his search for the truth. Detailed studies were made at a series of representative and yet widely separated stations. The author gives a detailed account of the methods used and the results obtained in the studies. The taxonomic features of the vegetation, the relative abundance of species, the size and age relations of dominant trees, the topographic situation, geological formations, soil characteristics and properties, the fire history, and the influence of disturbances by man were all investigated from the standpoint of the possibility of being causative factors.

The author, although freely admitting that at the beginning of his studies he thought that the peculiarities of the "Plains" vegetation were attributable to the inhibiting effect of unfavorable soil conditions, concludes that forest fires have been by far the most important factors in restraining the natural, dynamic developmental tendencies of the native vegetation by keeping it dwarfed far below its usual height and by holding it in a stage of the succession short of the climax. The very logical conclusion is advanced that, with effective protection from fire, the "Plains" areas are capable of supporting forest growth similar to that in the Pine Barrens. Also the proportion of the so-called better oaks, such as white oak (*Quercus alba*), black oak (*Q. velutina*), chestnut oak (*Q. montana*), and scarlet oak (*Q. coccinea*) will probably increase with the elimination of forest fires.

Through the decomposition of the resulting accumulation of litter a very desirable increase in the colloid complex would doubtless result from the increase of organic colloids rather than of inorganic colloids. The colloidal material is highly important both in absorption phenomena and in the absorption of water and nutrients by plants.

C. F. Korstian,
Duke Forest.

Handbook of Forest Practice for the West Coast Logging and Lumber Division. Covering the Rules of Forest Practice for the Douglas Fir Region under Article X of the Lumber Code. By W. B. Greeley, *Secretary-Manager, West Coast Lumbermen's Association, Seattle, Washington, pp. 28, 1934.*

This handbook is the first of its kind which has come out as a result of the efforts under the Lumber Code to introduce conservative practices on private forest lands. As the author states the Lumber Code contemplates perpetuation of both forests and forest-using industries by a sustained yield of timber.

As the JOURNAL readers well know the United States has been divided into different forest divisions for the purpose of enforcing the Lumber Code and under Article X rules for forest practice have been set up for each of these divisions.

The West Coast Logging and Lumber Division is among the first to effect an organization for applying the forest practice rules and to actually start the enforcement of these rules.

The purpose in issuing this handbook of forest practice is—"to help the individual West Coast logger to study his own operation and determine how he can best apply the various methods of cutting outlined in the divisional rules; or how he can develop a system of his own that will effectively adapt his layout and equipment to the requirements of the Code. The handbook brings together in convenient form information and past experience of West Cost loggers and foresters that will give each operator the scientific and practical ideas underlying the divisional rules. It will greatly aid an intelligent choice and application of the rules."

The idea of issuing a handbook for this purpose is one which can well be copied by other divisions throughout the country. There is no doubt that if Article X is to be made effective in the woods that there will have to be a great deal of educational work undertaken with the lumbermen.

While the information contained in this handbook is already known in large part to foresters and to many lumbermen, yet its presentation in its present form by the lumbermen themselves makes the material available in a way which will be most palatable and most easily understood by the men in the industry. The illustrations of cutting methods add to the usefulness of the handbook.

The Code authorities in other divisions should all possess themselves of a copy of this handbook and should seriously consider getting out something of a similar nature for the industry in their own division.

The handbook states that the essentials for obtaining continuous crops of timber in the Douglas Fir region are—adequate seed supply and fire protection. Most of the space in the handbook is given toward showing how these two essentials can be secured.

R. C. HAWLEY,
Yale School of Forestry.

The Use of Shallow Wells in Forest Fire Suppression. By Gilbert I. Stewart. *Michigan Department of Conservation. 64 pp. Illustrated. 1934.*

Forest fire suppression, along with most other activities of the modern workaday world, has joined the technological procession and is becoming mechanized. Perhaps the most significant, and, to this reviewer, the most interesting, developments in the use of mechanical equipment have occurred in the recent advances made with gasoline pumps. The Los

Angeles County Forestry Department has pioneered with great success in tank truck apparatus. And now the Michigan Department of Conservation in coöperation with the U. S. Forest Service announces, through this bulletin, the development of an entirely new technique in the use of pumping equipment.

The first mental reaction of the average person to the word "Fire!" is to think of water. Why? Simply because water has been the most speedy and common means of quenching flames since Prometheus stole fire from the heavens for man's benefit on earth.

It cannot be doubted that the use of water in forest fire extinction is both practical and efficient. Nevertheless, its use to control woodland conflagrations has been restricted for two reasons: first, its scarcity at the place where needed; secondly, the difficulty of getting it there.

A notable advance in the use of water on the fire line occurred with the perfecting of the portable spray tank and hand pump. This reviewer well remembers those earlier tanks with their faulty connections and easily clogged spraying devices, and the profane and generally uncomplimentary remarks by the veteran fire fighters asked to wield such inefficient tools on the fire line. However, today the hand fire pump is practically fool-proof and is a respected weapon in the fight against the scourge of the forest.

Similarly has the history of gasoline pumping equipment paralleled that of the spray tank. The pumper has been considered impractical by some forest protectors because of the difficulty of providing it with water upon all occasions. Now the fact of the matter is this: the pumper is not impractical at all; it is simply a tool of restricted use. And when this fact is appreciated and understood the pumper takes its rightful place among the effective equipment of the forest fire fighting job.

In this bulletin, Gilbert I. Stewart, who is directer of the Michigan Forest Fire Experiment Station located at Roscommon, tells considerable that is new about the proper field of usefulness for pumping equipment. He demonstrates that pumping sites are not necessarily restricted to lakes and streams, and shows how water supplies may be developed for use with power pumps.

He and his associates have perfected a two-man hand technique of sinking shallow wells by a hydraulic method, known as the "washing-in" method, which is quite dissimilar to the "jetting" method used by well drillers requiring power drilling rigs. The system is so dependable and certain that it is possible to place in service pumps of large capacity within 10 minutes after the start of operations!

In localities where the water table rises to a height of within 20 feet or less of the surface of the ground, the wells are absolutely reliable, and provide from 30 to 65 gallons per minute with suction pumps. The practical limit of depth is about 22 feet.

Barriers to the establishment of wells include large boulders, such as are found in till plains; bed rock and rock layers which can be pierced by power rigs only; and impervious soils, such as clay, heavy silts, and fine loams, which are impermeable and which do not permit the passage of water fast enough to supply suction pumps.

However, there are many places in the country where well pumping may be advantageously practiced, and this valuable publication points the way to a more widespread application of pumps in fire extinction. In the light of the research work done by the Michigan Forest Fire Experiment Station, the gasoline pump is seen to be not a cumbersome piece of equipment of extremely limited use,

but an exceedingly mobile type of fire fighting apparatus.

HENRY E. CLEPPER.

Forstliche Rundschau. Edited by Dr. Heinrich Weber. *Bd. 6 H. ¾ 1933, Neudamm, July, 1934.*

This number of the well-known forestry abstract journal continuing the *Forstliche Jahresbericht* contains 255 pages, divided about equally between abstracts of writings in German and in other languages. Although it attempts to cover all forestry literature in the world, the listing of non-German titles is of course extremely fragmentary. The correspondents in the principal European countries, Japan and the United States (Professor Recknagel reports for North America) must be greatly exerted to choose the few outstanding contributions from the enormous production in their area. Of course, when thumbing through a publication of this kind, one turns to one's own country. One and one-half pages (0.4 per cent) are devoted to North American forest literature. The following 15 publications of 1933 are mentioned:

Stuart: Report of the Forester—1933.

Cope: Growing wood as a crop on New York farms.

Bailey: Cultivated conifers of North America.

Hall: Post-logging decadence in northern hardwoods.

Westveld: Relation of soil characteristics to forest growth and composition in hardwood forests of northern Michigan.

Friend & West: European pine shoot moth. (Connecticut)

McIntyre: European pine shoot moth. (New York)

Howard: Forest Taxation. (New York)

Garver & Cuno: Portable band sawmill and selective logging in the loblolly forests of North Carolina.

Koroleff & Bryant: Transportation of wood in chutes. (1932)

Tyron: A portable charcoal kiln.

Brandstrom: Analysis of logging costs and operating methods in the Douglas fir region.

Anonymous: 23rd Annual Report New York Conservation Department.

JOURNAL OF FORESTRY (Oct., Nov. and Dec. 1933) (Titles of 5 pages listed as "principal contents.")

But it is unfair to imply that these are the only glimpses of American forestry invading the Oberforstmeister's, Arbeitszimmer. Scattered through the German literature part one finds abstracts from the JOURNAL OF FORESTRY and other sources made by the editors of specialties, such as pathology or management, which are often subdivdied by countries. This nothwithstanding, it is apparent that American forest literature, including Canadian, is neither adequately covered or represented. Japan, on the other hand, is allotted 7 pages and 82 titles, scantily abstracted. German literature seems to be very ably covered and as a key to German literature *Forstliche Rundschau* is commended for regular perusal.

The length and completeness of the abstracts are very variable in the different sections and impress the reviewer as being the result, not of any plan, but rather of the taste of the individual abstractor. Some are entirely too long and detailed in proportion to the length and importance of the original. Other important papers are mentioned by title only. Numerous cases of second and third-hand reviewing occur. In this, as in the form of abstract, it would seem that the editor and correspondents of this quarterly might profitably copy some matters of abstracting technique, from *Biological*

Abstracts. An example is the omission of such space-filling non-essentials as "This pamphlet is an interesting portrayal of" instead of telling plainly what the "meat" of the publication is. Most of the abstracts, incidentally, are hybrids between reviews and abstracts. All are in German. An author index is printed on the back cover, a welcome innovation. There is no subject index, other than the general subject contents. It is well-printed on substantial paper.

Although the reviewer feels obliged to point out the above remedial shortcomings, it is a real pleasure to observe how successful a hugely ambitious undertaking such as *Forstliche Rundschau* can be. It is our only forestry abstract journal and as such covers substantially more forestry literature than *Biological Abstracts.* It is indeed unfortunate that some co-operative effort cannot unite the two for the avoidance of duplication and general edification of foresters. (cf. note by the present reviewer; Jour. For. 31 (5): 591-593, 1933).

Forstliche Rundschau is obtainable from J. Neumann, Neudamm, Germany, for 28 RM. or about $13 per year, delivered in the United States.

HENRY I. BALDWIN.

CORRESPONDENCE

Mr. H. H. Chapman, President,
Society of American Foresters.

Dear Sir:—

It is for the first time, since I became a member of the Society of American Foresters, that I can frankly say that I have thoroughly enjoyed reading an issue of the Journal of Forestry (December issue). Its contents were both interesting and instructive.

I am one of the many foresters among the younger generation who has been sending six dollars a year to Suite 810, Hill Building, Washington, D. C., to support an organization that has been publishing a Journal which is supposedly a summary of views, opinions and criticisms of current forestry problems of general interest to members of the profession but which in reality is a publication containing articles of such local and technical interest that few members benefit by the information.

I was not in the least surprised when I opened the December issue to Society Affairs and found a list of members who had been dropped for non-payment of dues. I am personally acquainted with some of the men on that list and know that they are working at the present and are well qualified for their positions. Their action is a mute indication of the sentiment of the younger foresters toward the Society.

I am a member of the Ohio Valley Section and have attended two of the sectional meetings during the three years that I have been a member of the Society. My observations of the attendance at these meetings indicate to me that over 50 per cent of the members have, as their only contact with the organization, the Journal of Forestry. If the publication itself can not be of greater interest, what will young members who never have an opportunity to attend a sectional meeting think of the Society?

The articles on the Shelter Belt Project, the CCC and the "Committee of Twelve" were very interesting. I feel quite sure that if the contents of future publications are similar to that of the December issue, there will be a greater general interest in the Society.

J. C. Baker,
ECW Technician, Illinois.

Editor, Journal of Forestry,

Dear Mr. Reed:

Your letter of December 13 came duly to hand and a few days later the copies of the Journal of Forestry arrived. I have read those very carefully, including other items besides the ones you noted and want first of all to congratulate you upon the character of the publication. It seems to be an admirable means of bringing before the real workers in this field what are important problems in connection with their professional activity.

I can not help mentioning in passing that among the various people listed I found quite a number who were formerly students of mine, especially at the University of Nebraska. Carlos Bates was one of those, a very brilliant young student. Teachers always take satisfaction

in saying "I told you that that boy would make his mark." It certainly is true here. His discussion was one of the clearest reviews of the situation from all aspects.

In general I was impressed by the fact that the objections were specific and the supporting articles of the optimistic type represented a fine attitude of mind but contained material that was less useful for reaching a verdict on the probable success of the project. In these I do not see much to change my opinion even though I realize that I am entirely untrained in this field. I am sure you realize that all I said in personal talk was far from calculated to pass criticism on those of professional training who may see some possibilties in a project that must appeal sentimentally.

If you have not seen in the *Engineering News Record* some time back a letter signed Leonardo di Galileo, headed "If the Tree Belt Should Fail," I think you would enjoy it.

HENRY B. WARD,
Permanent Secretary,
Amer. Assoc. for the Advancement of Science.